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REMEDIAL ACTION CONSTRUCTION AND COMPLETION REPORT

LANDFARM REMEDY

Prewitt Refinery Site
Prewitt, NM

Prepared for:

Atlantic Richfield Company/
El Paso Natural Gas Company

February 1997

Volume 1 of 2

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Volume 1 of 2

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ACRONYMS AND ABBREVIATIONS

This document utilizes the following organization abbreviations. Abbreviations used in the Contract Documents shall be interpreted according to their recognized and well-known technical or trade meanings; such abbreviations include but are not limited to the following:

AHA	Applied Hydrology Associates, Inc.
ARCO	Atlantic Richfield Company
AVM	AVM Environmental Services
COE (or U.S. COE)	U.S. Corps of Engineers
DOT (or U.S. DOT)	U.S. Department of Transportation
EPA (or U.S. EPA)	U.S. Environmental Protection Agency
EPNG	El Paso Natural Gas Company
HLA	Harding Lawson Associates
NMED	New Mexico Environment Department
NSP	Navajo Superfund Program
OSHA	Occupational Safety and Health Administration

Common technical abbreviations which may be found in this report are listed below:

ACM	Asbestos Containing Materials
AHERA	Asbestos Hazard Emergency Response Act
amsl	Above Mean Sea Level
BTU	British Thermal Unit
C	Carbon
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CPC	Contaminants of Potential Concern
cu. yd.	Cubic Yard
EPA	Environmental Protection Agency
ft.	Feet
HASP	Health and Safety Plan
HDPE	High Density Polyethylene

ACRONYMS AND ABBREVIATIONS
(Continued)

HEPA	High Efficiency Particulate Absolute
hr.	Hour
HP	Horse Power
kg	Kilogram
L	Liter
lb, lbs	Pound, Pounds
LTRA	Long Term Remedial Action
LTSs	Landfarm Treatment Standards
mg.	Milligram
mg/L	Milligram per Liter
MDD	Maximum Dry Density
MDL	Method Detection Limit
N	Nitrogen
NAPL	Non-Aqueous Phase Liquid
NPL	National Priorities List
O&G	Oil and Grease
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
P	Phosphorus
PAH	Polynuclear Aromatic Hydrocarbons
PLM	Polarized Light Microscopy
PNA	Polynuclear Aromatic Hydrocarbons
ppb	Parts Per Billion
PPE	Personal Protective Equipment
ppm	Parts Per Million
PRP	Potentially Responsible Party
QAP	Quality Assurance Plan
QA/QC	Quality Assurance/Quality Control
RA	Remedial Action
RCRA	Resource Conservation and Recovery Act of 1976 (PL-94-580)

ACRONYMS AND ABBREVIATIONS
(Continued)

RD	Remedial Design
RD/RA	Remedial Design/Remedial Action
RFP	Request for Proposal
RI	Prewitt Refinery Site Remedial Investigation (February 21, 1992)
ROD	Record of Decision
SAP	Sampling and Analysis Plan
RI/FS	Remedial Investigation/Feasibility Study
RPM	EPA Remedial Project Manager
SC/QAO	Supervision Contractor/Quality Assurance Official
sq. ft.	Square Foot
SOW	Statement of Work
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total Petroleum Hydrocarbons
μg/L	Microgram Per Liter
VOC	Volatile Organic Carbon
yr	Year

EXECUTIVE SUMMARY

The Prewitt Refinery Superfund Site is a former crude oil refinery located in McKinley County, New Mexico, approximately 20 miles northwest of Grants, New Mexico. The refinery was in operation from approximately 1938 to 1957 and was dismantled in 1966. The Site was placed on the National Priorities List on August 30, 1990 by the US Environmental Protection Agency, Region VI (EPA). The Record of Decision (ROD) prescribing the remedial activities to be undertaken at the Site was issued by EPA on September 30, 1992. A Unilateral Administrative Order, Docket Number 6-17-93 (The Order) was issued jointly to ARCO and EPNG on May 14, 1993. The Order required ARCO and EPNG to conduct the Remedial Design (RD) and the Remedial Action (RA) in accordance with the ROD.

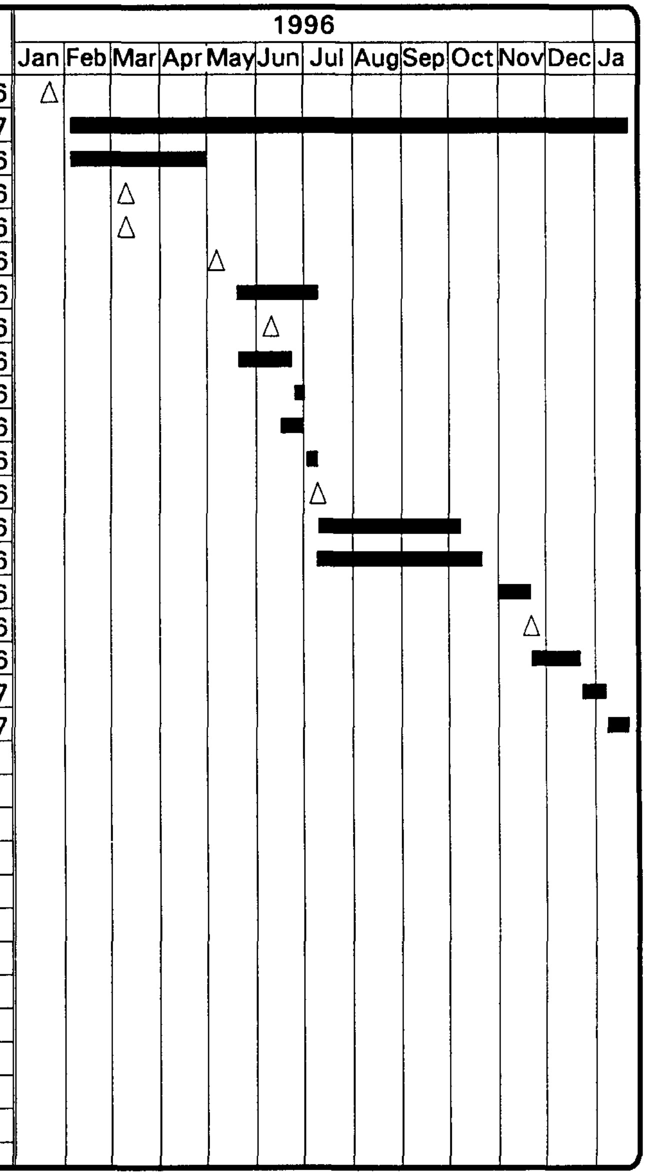
In discussions with EPA's Remedial Project Manager (RPM), it was agreed that the RA Construction Report and the RA Completion Report required by the Order for the Landfarm Remedy be combined into one RA Construction and Completion Report. This report documents the construction of the landfarm, provides "as-built" construction and closure drawings, includes analytical results of confirmatory sampling which demonstrate compliance with hydrocarbon soil excavation standards, provides analytical results of landfarm performance monitoring which demonstrate compliance with landfarm treatment standards, and includes certification by a Professional Engineer that the work was conducted in accordance with the RD. The Landfarm Remedy included construction of the landfarm, excavation and placement of hydrocarbon contaminated soils and west pits content for treatment in the landfarm, operation of the landfarm, performance monitoring, and placement of soil and vegetative cover over the treated soils, as summarized in the following sections.

Pre-Construction Conference & Implementation Schedule

A Pre-Construction Conference was held on May 7, 1996 prior to the start of construction. The proposed construction schedule was reviewed. July 2, 1996 was set as the target goal for application of all hydrocarbon soils to the landfarm. The RA for the Landfarm Remedy was implemented as summarized in the schedule provided in Figure EX-1.

EX-1. Remedial Action Completion Schedule

Task Name	Duration	Start	End
RA Work Plan Addendum Approval	0.00 d	Jan/22/96	Jan/22/96
Landfarm RA	244.00 d	Feb/05/96	Jan/23/97
Contracting Process	62.00 d	Feb/05/96	May/01/96
Locating & Sampling West Pits & HC Soils	0.00 d	Mar/11/96	Mar/11/96
Sampling Stockpile of Previously Excavated Soils	0.00 d	Mar/11/96	Mar/11/96
Pre-Construction Conference	0.00 d	May/07/96	May/07/96
Site Preparation & Construction of Landfarm	36.00 d	May/20/96	Jul/10/96
Finish Clay Liner Construction & Testing	0.00 d	Jun/11/96	Jun/11/96
Excavation of HC Soils	24.00 d	May/21/96	Jun/24/96
Backfill HC Soil Excavations	5.00 d	Jun/26/96	Jul/02/96
Homogenization of HC Soil & Placement in Landfarm	11.00 d	Jun/17/96	Jul/01/96
Off-Site Disposal of Trash, Pipe and PPE	5.00 d	Jul/03/96	Jul/10/96
Landfarm PreFinal Inspection	0.00 d	Jul/10/96	Jul/10/96
Draft Landfarm Construction Report	64.00 d	Jul/11/96	Oct/09/96
Landfarm Operation and Maintenance	73.00 d	Jul/10/96	Oct/22/96
Landfarm Closure	15.00 d	Nov/01/96	Nov/22/96
Landfarm Pre-Certification Inspection	0.00 d	Nov/22/96	Nov/22/96
Draft Landfarm RA Completion Report	21.00 d	Nov/22/96	Dec/23/96
EPA Review and Certification of Completion	10.00 d	Dec/24/96	Jan/08/97
Final RA Completion Report for Landfarm Remedy	10.00 d	Jan/09/97	Jan/23/97



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Milestone △ Summary

Landfarm Construction

Site preparation and baseline surveying for landfarm construction began on May 20, 1996. This work included establishing storm water controls; stripping vegetation from the construction locations; preparing the landfarm subgrade; and constructing water run on/run off protection berms. Hydrocarbon-stained soil encountered during subgrade preparation was excavated on May 21, 1996 and temporarily stockpiled near the West Pits for placement in the landfarm.

The clay soil from the previously characterized borrow area was used for clay liner construction. Liner compaction requirements were confirmed on June 11, 1996 using the sand cone test method and nuclear density gage measurements. Also, elevation surveys and clay liner thickness measured at each sand cone test location showed that the liner thickness exceeded the minimum of six inches specified in the RD.

The lined storm water and seepage collection basin was constructed at the toe of the landfarm treatment cell prior to placing the buffer layer above the clay liner. The thickness of the soil buffer layer was confirmed to be more than the required four inches by surveying. The installation of the sprinkler/irrigation system and the geomembrane erosion protection for the berms was completed on July 10, 1996 after placing the treated soils in the landfarm.

Excavation of Hydrocarbon Soils and the West Pits

Prior to the excavation, sampling was conducted at locations in the Railroad, North Pit, and West Pits areas to further delineate the vertical extent of contamination and to provide better control of the excavation of hydrocarbon soils. Samples of the hydrocarbon soils stockpiled at the West Pits location were also taken. The concentrations of Polynuclear Aromatic Hydrocarbons (PAHs) in these stockpiled soils were found to be below the landfarm treatment standards. Therefore, as agreed upon by EPA, the stockpiled soils did not require treatment and were used to construct the buffer soil layer above the clay liner.

The excavation of hydrocarbon-contaminated soils was conducted in accordance with the RD. Excavation of hydrocarbon-contaminated soils from both the Railroad areas and the West Pits started on June 13th and was completed on June 26th. Additional hydrocarbon soils were encountered and removed from three areas which were not identified in either the RI or the RD.

Following excavation, confirmatory sampling was performed which demonstrated that the clean-up standards were attained for excavation of hydrocarbon-contaminated soil and West Pits. After review of confirmatory sampling results and inspection of the excavations with EPA oversight personnel, the excavations were backfilled with clean soil. Surveys of pre-excavation topography and final backfill elevations were performed to verify the excavation had been backfilled to at least the original grade. Following backfilling and grading of the hydrocarbon soil excavations, the graded areas were fertilized, disked and revegetated.

Homogenization of Hydrocarbon Soils and Placement in the Landfarm

Excavated soils were transported to the soil preparation area where soil was homogenized in batches. Homogenized soils were placed in thirteen stockpiles, containing a total of approximately 4,300 cubic yards of soil. Samples were taken from soil stockpiles to determine the required nutrient addition and to verify hydrocarbon loading.

The homogenized soils from the 13 stockpiles were mixed and placed in the landfarm, above the buffer layer. Two to three inches of soils from the areas where hydrocarbon soils were homogenized and stockpiled were also excavated to remove any residual contamination and placed in the landfarm for treatment. Granular nutrients were applied using a broadcaster and mixed into the soils with a rotor-tiller to achieve the C:N:P ratio of 100:5:1. Application of hydrocarbon soils in the landfarm was completed before the July 2, 1996 goal.

Pre-Final Inspection of Landfarm Construction

A Pre-Final Inspection of the constructed Landfarm Remedy was conducted by the EPA on July 10, 1996. The Pre-Final Conference included an inspection of all soil excavation areas and the constructed landfarm, review of confirmatory sampling results, and an inspection of sprinkler operation. A conference call was conducted on July 11, 1996 to discuss the results of the Pre-Final Inspection with the ARCO and EPNG Project Managers. EPA indicated that there were no outstanding items related to landfarm construction.

Landfarm Operation and Maintenance

Landfarm O&M activities were started the week of July 15, 1996. The landfarm O&M included tilling twice per week to maintain adequate aeration. Irrigation was conducted as needed to maintain optimum soil moisture for biodegredation of contaminants of potential concern. Weekly sampling for moisture and pH and monthly sampling for nutrients and hydrocarbon were performed in accordance with the RD. Nutrients were also applied during O&M to maintain the optimum carbon/nutrient ratios.

Landfarm O&M involved treatment of the hydrocarbon soils and the West Pits contents in the landfarm until performance monitoring demonstrated that treatment performance standards were attained. On July 5, 1996, four composite samples of the landfarm soil were collected to determine landfarm soil baseline (pre-treatment) concentration of PAHs. The results showed an average benzo(a)pyrene equivalent total concentration of 4.1 ppm, which is less than the 4.5 ppm landfarm treatment standard.

Although the baseline results indicated that treatment levels had already been attained, landfarm O&M was conducted starting on July 15, 1996 and performance monitoring was completed on August 20, 1996 to confirm that the Polynuclear Aromatics (PNAs) content of the landfarm soils were below the treatment standard. The performance monitoring results showed an average benzo(a)pyrene equivalent total concentration of 2.1 ppm.

EPA requested that a second round of landfarm soil treatment performance monitoring be conducted to confirm that the landfarm soil PAHs concentrations were below the treatment standards. The composite samples were collected on September 16, 1996. The results showed an average benzo(a)pyrene equivalent total concentration of 3.6 ppm, which is well below the 4.5 ppm landfarm treatment standard.

The O&M activities for landfarm remedy continued until October 22, 1996 when the EPA Remedial Project Manager (RPM) notified the EPNG Project Manager and the O&M Contractor that the performance monitoring results, as well as the US Army Corps. of Engineers (COE)'s QA/QC sample results indicate that the landfarm treatment standards had been attained.

Landfarm Closure

Closure of the landfarm started on November 1, 1996. Prior to constructing the required soil and vegetative cover, the treated soils in the northern half of the landfarm treatment cell were moved to the southern half of the cell so that a uniform soil cover of at least one foot in thickness could be placed over the treated soil even with the surrounding topography. Also, the geomembrane covering the berms, the sprinkler irrigation system, the hay bale berm, and the catch basin liner were removed. The debris from landfarm closure were sent to the Waste Management disposal facility in Rio Rancho, New Mexico.

The closure soil cap was constructed in lifts using clean soil from the landfarm berms and soil from the borrow area. The final surveying, which was completed on November 22, 1996, showed an average cap thickness of nearly 1.4 feet. Revegetation of the soil cap was completed on December 5, 1996. With construction of the vegetated soil cover cap over the landfarm soils which were treated to below the treatment standard specified in the ROD, the potential exposure risk at the former landfarm location is less than 1×10^{-6}.

Pre-Certification Inspection of Landfarm Remedy

A Pre-Certification Inspection of the Landfarm Remedy was conducted by EPA on November 22, 1996. Details of the landfarm closure activities were reviewed and the final grading of the former landfarm area was inspected. EPA was notified that revegetation and off-site disposal of debris derived from landfarm closure would be completed by the first week in December. With completion of these items, the EPA RPM indicated that landfarm closure work was acceptable and complete and that the Pre-Certification Inspection would also serve as the Final Certification Inspection.

EPA Certification of Completion

Following the pre-final and final certification inspection and review of the Draft Remedial Action Construction and Completion Report, the EPA issued a certification of completion of the landfarm remedy.

1.0 INTRODUCTION

1.1 Purpose and Organization of the Report

This Remedial Action (RA) Construction and Completion Report addresses the construction, the operation and maintenance (O&M), and the closure of the Landfarm Remedy at the Prewitt Refinery Site. This Report documents the physical construction of the landfarm, and provides as-built drawings. It includes documentation and analytical results of confirmatory sampling which demonstrate compliance with hydrocarbon soil excavation standards. The report also provides analytical results of landfarm performance monitoring which demonstrate compliance with landfarm treatment standards. A certification by a Professional Engineer that the work has been conducted in accordance with the RD is also included.

The construction of the Landfarm Remedy included:

- Excavation of hydrocarbon-contaminated surface soils and the West Pits.
- Construction of the landfarm treatment cell.
- Homogenization of all excavated hydrocarbon soils, including separator subsoils and hydrocarbon soils, previously excavated during Surface Remediation and debris removal.
- Addition of clean soil and nutrients as required for optimal loading and carbon/nutrient rations for landfarm treatment.
- Placement of homogenized soils in the landfarm for treatment.

Landfarm O&M involved treatment of the hydrocarbon soils and West Pits contents in the landfarm until performance monitoring demonstrated that treatment performance standards were attained. The landfarm O&M included tilling and irrigation to maintain adequate aeration and optimum soil moisture to promote biodegradation of contaminants of potential concern (CPC's) in the landfarm. Nutrients were also applied during O&M to maintain the optimum carbon/nutrient ratios.

Closure of the landfarm following completion of active biotreatment involves removing the geotextile and collection basin liner, and covering treated soil with a soil and vegetative cover.

This RA Construction and Completion Report for the Landfarm Remedy at the Prewitt Refinery Superfund Site is prepared and submitted in accordance with the Unilateral Administrative Order, Docket Number 6-17-93 (The Order) issued jointly to ARCO and EPNG on May 14, 1993. The first six chapters of this report were submitted in accordance with the Order and EPA approved RA Work Plan Addendum 1 which required ARCO and EPNG to submit a RA Construction Report for the Landfarm Remedy within 90 days following completion of the Pre-final Inspection.

This Chapter (Chapter 1) describes the purpose and scope of the report, and provides background information. It also describes the RA objectives, the clean-up standards, and the remedial design (RD) requirements. Chapter 2 describes previous work related to implementation of the Landfarm Remedy and initiation of RA construction work at the Site. Chapter 3 describes the landfarm subgrade preparation and landfarm construction, including compaction testing of the clay liner. Chapter 4 describes the excavation and temporary stockpiling of hydrocarbon-contaminated soils and West Pits contents. Chapter 4 also includes the results of confirmatory sampling of hydrocarbon soil excavations which demonstrate compliance with the hydrocarbon soil and West Pits clean-up standards. Chapter 5 describes the preparation of soils for land farming and placement in the landfarm. Chapter 6 describes the inspection and construction completion of the Landfarm Remedy, including the Pre-Final Inspection.

Chapters 7 and 8 were prepared and submitted in accordance with the Section IX, B(56) of the Order which required ARCO and EPNG to submit a written report, within 30 days following the pre-certification inspection which demonstrates that the performance standards have been attained, and certifies that the remedial action has been completed in full satisfaction of the requirements of the Order. Chapter 7 describes the landfarm operation and maintenance activities, and performance monitoring, including the analysis results which demonstrate attainment of the landfarm treatment standards. Chapter 8 describes the closure of the landfarm, including backfilling, grading and revegetation. Chapter 8 also describes the Pre-Certification Inspection and includes the EPA certification of completion of the Landfarm Remedy.

1.2 Background

The Prewitt Refinery Superfund Site is a former crude oil refinery located in McKinley County, New Mexico, approximately 20 miles northwest of Grants, New Mexico. The refinery was in operation from approximately 1938 to 1957. The refinery was dismantled in 1966. The Prewitt Refinery was placed on the National Priorities List on August 30, 1990, pursuant to Section 105 of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), by the U.S. Environmental Protection Agency, Region VI (EPA). A Remedial Investigation/Feasibility Study was conducted by Atlantic Richfield Company (ARCO) and El Paso Natural Gas Company (EPNG) pursuant to a Consent Order jointly issued to ARCO and EPNG on July 26, 1989. The Prewitt Refinery Site Remedial Investigation (RI) was submitted to EPA on February 21, 1992. The Prewitt Refinery Site Feasibility Report (FS) was submitted to EPA on February 27, 1992. Prior to completion of the FS, comprehensive pilot tests for extraction of Non-Aqueous Phase Liquids (NAPLs) were performed at both the North NAPL and the South NAPL areas at the Site. The results of the Pilot Tests and a Supplemental FS describing a combined ground water and NAPL remedy were submitted to EPA in April 1992.

The Record of Decision (ROD) for the Site was issued by EPA on September 30, 1992. The remedial action for the Site selected by EPA in the ROD includes the following six components: 1) excavation and off-site disposal of asbestos-containing materials and soils; 2) excavation and off-site disposal of lead contaminated soil; 3) excavation and off-site disposal of separator and its contents; 4) Soil Vapor Extraction of NAPL; 5) ground water extraction and reinjection; 6) excavation and land farming of West Pits contents and hydrocarbon-contaminated soils.

1.3 Remedial Action Objectives and Performance Standards

The remedial objectives for hydrocarbon-contaminated soils and West Pits contents as described in the ROD are: "1) to eliminate potential exposure via ingestion, inhalation, or direct content with contaminants and 2) to reduce the potential for the soil to act as a continued source for ground water contamination". The contaminants of potential concern (CPC) for the West Pits contents and hydrocarbon-contaminated soil are the carcinogenic polynuclear aromatic hydrocarbons (PAHs) presented in Table 1-1.

The hydrocarbon-contaminated soils and West Pits contents were to be excavated and treated to a level such that an excess cancer risk of 10^{-5} is not exceeded assuming future residential use of the Site. The clean-up standard for remediation of surface soils (0-2 feet), as stated in the ROD, is "0.9 benzo(a)pyrene equivalents, which translates to 0.9 mg/kg for benzo(a)pyrene; 9.0 mg/kg for benzo(a)anthracene, benzo(a)fluoranthene, and benzo(b)fluoranthene; and 90 mg/kg for chrysene." When carcinogenic PAHs are found in combination, their carcinogenic risks are considered additive. When excavated areas are backfilled with clean soil, the actual risk at the surface, where exposure is more likely, is less than 10^{-6}.

The only exposure to subsoils (2-4 feet below surface) under future residential use of the Site, could be to construction workers. The clean-up standard for remediation of subsoils (2-4 feet below surface) specified in the RD is "20.3 benzo(a)pyrene equivalents, which translates to 20.3 mg/kg for benzo(a)pyrene; 203 mg/kg for benzo(a)anthracene, benzo(a)fluoranthene, and benzo(b)fluoranthene; and 2030 mg/kg for chrysene." No exposure pathway exists to future residents or construction workers below 4-feet in depth and, therefore, no risk is posed by PAHs in soils at depths greater than 4 feet below the surface.

As specified in the ROD, the standard for treatment of hydrocarbon-contaminated soils and West Pits contents in the landfarm prior to closure is "4.5 benzo(a)pyrene equivalents, which translates to 4.5 mg/kg for benzo(a)pyrene; 45 mg/kg for benzo(a)anthracene, benzo(a)fluoranthene, and benzo(b)fluoranthene; and 450 mg/kg for chrysene." The soils treated to these standards will present an excess cancer risk of less than 5×10^{-5}. When the landfarm soils are covered with clean soil and a vegetative cover, the actual risk at the surface in the closed landfarm area will be less than 10^{-6}.

The performance standards for excavation and treatment of the West Pits contents and hydrocarbon-contaminated soil are summarized in Table 1-1. This table includes the RD specified clean-up levels necessary to meet the requirements of the ROD based on a future residential use scenario.

Table 1-1. CPC's, Excavation Performance Standards for Soils, and Treatment Standards for Landfarm Closure

Contaminant of Potential Concern (CPC)	Excavation Performance Standards for Surface Soils (0-2 feet)	Excavation Performance Standards for Subsoils (2-4 feet)	Treatment Standards for Landfarm Closure
Benzo(a)pyrene[1]	0.9 mg/kg	20.3 mg/kg	4.5 mg/kg
Benzo(a)anthracene[1]	9.0 mg/kg	203.0 mg/kg	45.0 mg/kg
Benzo(a)fluoranthene[1]	9.0 mg/kg	203.0 mg/kg	45.0 mg/kg
Benzo(b)fluoranthene[1]	9.0 mg/kg	203.0 mg/kg	45.0 mg/kg
Chrysene[1]	90.0 mg/kg	2030.0 mg/kg	450.0 mg/kg

1 When carcinogenic PAHs are found in combination, their carcinogenic risks are considered additive. Therefore, when two or more carcinogenic PAHs are found together, the individual PAH concentrations which were to be met following excavation or treatment were adjusted to benzo(a)pyrene equivalents.

1.4 Remedial Design

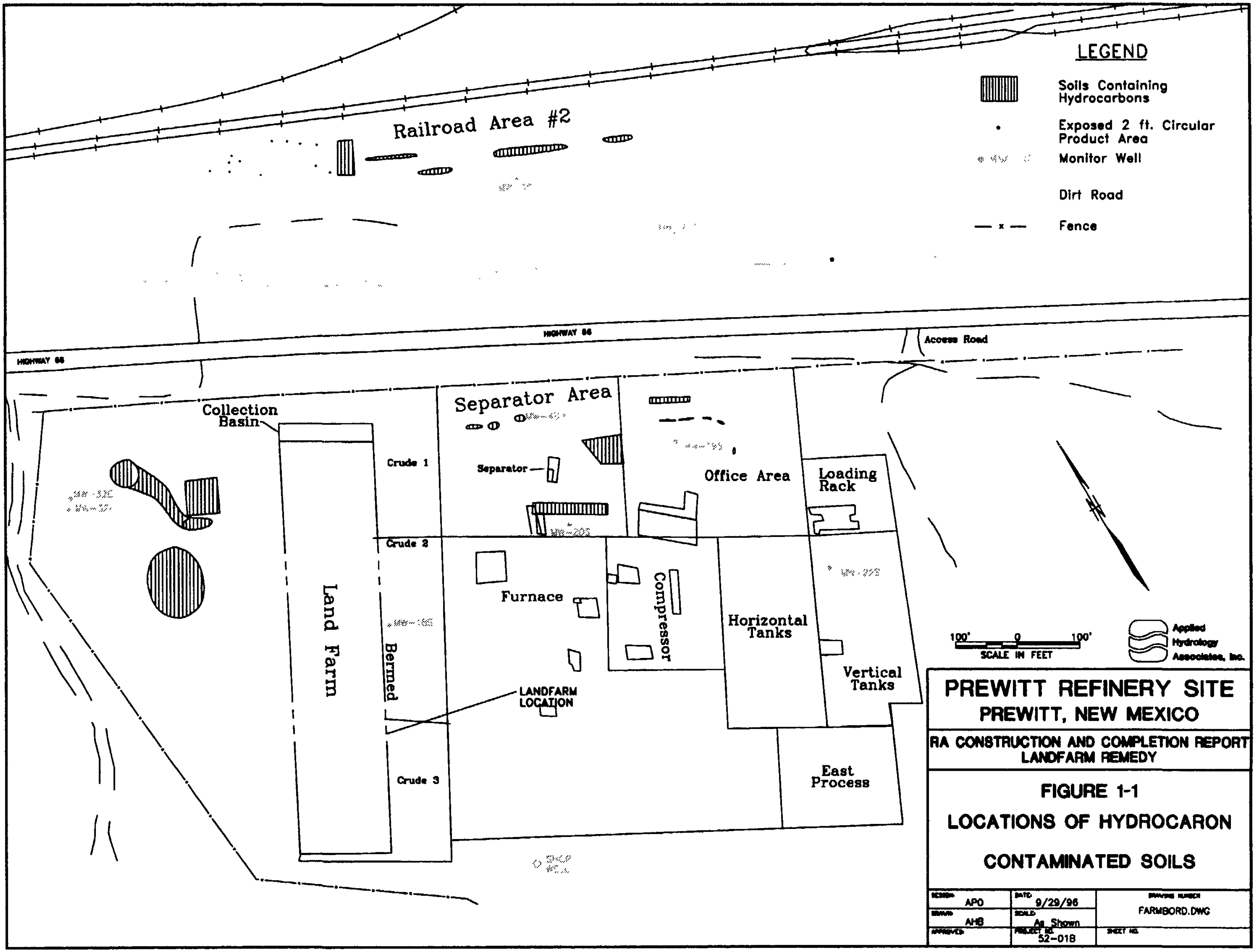
The RD Report for Landfarm Remedy (Volume 4 of the RD) prepared by ARCO/EPNG in compliance with the approved RD Work Plan and the Order, was approved by EPA on October 24, 1995. This RD report provided design plans and specifications for the facilities, and activities for the Landfarm Remedy.

The RD estimated the volume of hydrocarbon contaminated soil requiring treatment in the landfarm to be about 3,000 cubic yards. The RD specified a 2.25 acre size for the landfarm based on an expected volume of placed soil (mixed and homogenized) of 4,000 cubic yards and a depth of 1.1 feet. This design included a contingency for placement of up to 6,000 cubic yards and a maximum depth of 1.5 feet.

Figure 1-1 shows the location of West Pits and hydrocarbon-contaminated soils, and the location of the landfarm from the RD. The landfarm was located to accommodate the required landfarm surface area. The location was selected based on its close proximity to the West Pits and on the minimal interference with Site wells, hydrocarbon soil excavations, and previously revegetated surface.

The RD provided descriptions and specifications for landfarm construction including the 40-mil, HDPE lined, run off seepage collection basin and the minimum 6-inch compacted clay liner. The RD specified that the compaction of the clay liner be confirmed by field measurements using a sand-cone method (ASTM D-1556) or a nuclear density method (ASTM D-2922). A design of the sprinkler/irrigation system using the Shop Well as a water source is also provided in the RD. The design calls for installation of sprinklers on 130 foot spacing on the east, west and south berms of the landfarm.

The RD specified homogenization of excavated soils to remove rocks, sticks and construction rubble which would interfere with landfarm treatment. Soil homogenization is also performed to obtain a more uniform soil for landfarm treatment. The RD also specified sampling of excavated soils to determine hydrocarbon loading rate, and concentrations of nitrogen (N), phosphorous (P), and carbon (C). Based on these sampling results, nutrients and/or clean soil are added to achieve the optimum C:N:P ratios and optimum hydrocarbon loading rates specified in the RD. The O&M procedures and monitoring requirements are also provided in the RD.



LEGEND
Soils Containing Hydrocarbons
Exposed 2 ft. Circular Product Area
Monitor Well
Dirt Road
Fence
Railroad Area #2
HIGHWAY 66
HIGHWAY 66
Access Road
Collection Basin
Separator Area
Separator
Office Area
Loading Rack
Crude 1
Crude 2
Crude 3
Land Farm
Bermed
Furnace
Compressor
Horizontal Tanks
Vertical Tanks
East Process
LANDFARM LOCATION
100' 0 100'
SCALE IN FEET
Applied Hydrology Associates, Inc.
PREWITT REFINERY SITE
PREWITT, NEW MEXICO
RA CONSTRUCTION AND COMPLETION REPORT
LANDFARM REMEDY
FIGURE 1-1
LOCATIONS OF HYDROCARON
CONTAMINATED SOILS
APO
9/29/96
FARMBORD.DWG
AHB
As Shown
52-018

2.0 INITIATION OF REMEDIAL ACTION FOR THE LANDFARM REMEDY

The Landfarm Remedy Construction included construction of the landfarm, excavation of hydrocarbon-contaminated surface soils and the West Pits, mixing and homogenization of all hydrocarbon-contaminated soils, including separator subsoils and previously excavated hydrocarbon soils, and placement of these soils in the landfarm for treatment. EPNG/ARCO implemented the construction of the Landfarm Remedy in accordance with the RD Report and with the approved RA Work Plan Addendum 1.

This chapter describes the excavation of separator subsoils and hydrocarbon soils during RA activities conducted in 1995. It also describes the sampling performed prior to the start of the excavation of remaining hydrocarbon contaminated soils and West Pits to further delineate the vertical extent of PAH contamination at these locations. A description of the pre-construction activities, including RA Contractor selection and construction mobilization is also provided.

2.1 Previously Excavated Hydrocarbon Contaminated Soils

Separator subsoils and potential hydrocarbon-contaminated soils, encountered during debris removal work and RA activities performed at the Site in 1995, were temporarily stockpiled at the West Pits location as described in Chapter 5 of the April 1996 RA Completion Report for Asbestos Containing Material, Lead-Contaminated Soil, and the Separator. Suspected hydrocarbon contaminated soil, encountered during this work, were excavated in accordance with the approved RD. Separator subsoils and drill cuttings were also sampled for total lead and TCLP lead before stockpiling.

Confirmatory soil samples were collected, in accordance with the RD, and analyzed for PAHs at all hydrocarbon soil excavations of less than 4 feet in depth. The confirmatory sampling, conducted during this work, showed that clean-up criteria for hydrocarbon soils were attained at all the excavations of hydrocarbon soil. Where confirmatory samples were not required, because there is no action level for excavations at depths greater than 4 feet, field measurements were taken to confirm excavation depths.

A total quantity of approximately 2,000 cubic yards of non-hazardous, hydrocarbon soil were excavated and temporarily stockpiled. These soils included:

- 106 cubic yards of separator subsoils excavated during implementation of the remedy for the separator,

- 200 cubic yards of hydrocarbon-stained subsoil excavated after completion of the lead-contaminated soil removal in the separator area,

- 160 cubic yards of hydrocarbon soil excavated during construction of the subsurface system, and

- 1530 cubic yards of hydrocarbon soils excavated during debris removal, including the West Pit located east of the separator, hydrocarbon soils in the vicinity of well MW-20S, and hydrocarbon soils located southwest of the separator as shown in Figure 2-1.

After discussion and approval from EPA, these hydrocarbon soils were placed in a temporary stockpile located on top of a dry waste pit in the West Pits Area, designated as Pit S in Figure 2-1. It was suspected that the concentrations of PAHs in this hydrocarbon soil stockpile would be below the landfarm treatment standard for two reasons:

- The hydrocarbon soils were identified and excavated based on visual screening followed by confirmatory sampling which showed that the total benzo(a)pyrene equivalent at all the excavations were well below the landfarm treatment standard.

- The separator subsoils placed in the stockpile were excavated during implementation of the remedy for the separator as required by the RD even though there was no visual indication of hydrocarbon contamination beneath the separator.

Following discussions with EPA, it was agreed that the soil stockpile would be sampled and analyzed for PAHs and, if the concentrations were below the treatment standard of 4.5 ppm total benzo(a)pyrene equivalent, the soil would be used to construct the buffer soil layer between the clay liner and the hydrocarbon soils.

Consequently, on March 11, 1996, five-point composite samples were collected from each of the four quadrants of the hydrocarbon soil stockpile. The four composite samples were analyzed for PAHs (semi-volatiles) by ACZ laboratories. The analytical results from confirmatory sampling are provided in Appendix 2.1 and are summarized in Table 2-1. Individual PAHs were converted to a benzo(a)pyrene equivalent based on a relative poency to benzo(a)pyrene of 0.1 for benzo(a)anthracene, benzo(b)fluoranthene, and benzo(k)fluoranthene, and of 0.01 for chrysene. A total benzo(a)pyrene equivalent is determined by summing the equivalent concentration for each constituent.

Table 2-1. PAH Analyses of Previously Excavated Hydrocarbon Soil Stockpile

	HC Stockpile, SE Quad			HC Stockpile, NE Quad		
PAH	Conc. ppm	Q	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q	Benzo (a)pyrene Equiv., ppm
Benzo(a)anthracene	0.960	J	0.096	2.640	U	0.264
Benzo(b)fluoranthene	2.640	U	0.264	2.640	U	0.264
Benzo(k)fluoranthene	2.640	U	0.264	2.640	U	0.264
Chrysene	2.640	U	0.026	2.640	U	0.026
Benzo(a)pyrene	2.900		2.900	2.640	U	2.640
TOTAL			**3.55**			**3.46**

	HC Stockpile, SW Quad			HC Stockpile, NW Quad		
PAH	Conc. ppm	Q	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q	Benzo (a)pyrene Equiv., ppm
Benzo(a)anthracene	1.320	U	0.132	1.320	U	0.132
Benzo(b)fluoranthene	1.320	U	0.132	1.320	U	0.132
Benzo(k)fluoranthene	1.320	U	0.132	1.320	U	0.132
Chrysene	1.320	U	0.013	1.320	U	0.013
Benzo(a)pyrene	1.200	J	1.200	1.600		1.600
TOTAL			**1.61**			**2.01**
				MEAN		**2.66**

Q FORMAT: "U" Indicates compound was not detected
"J" Indicates compound detected < MDL
"B" Indicates compound was found in daily calibration blank

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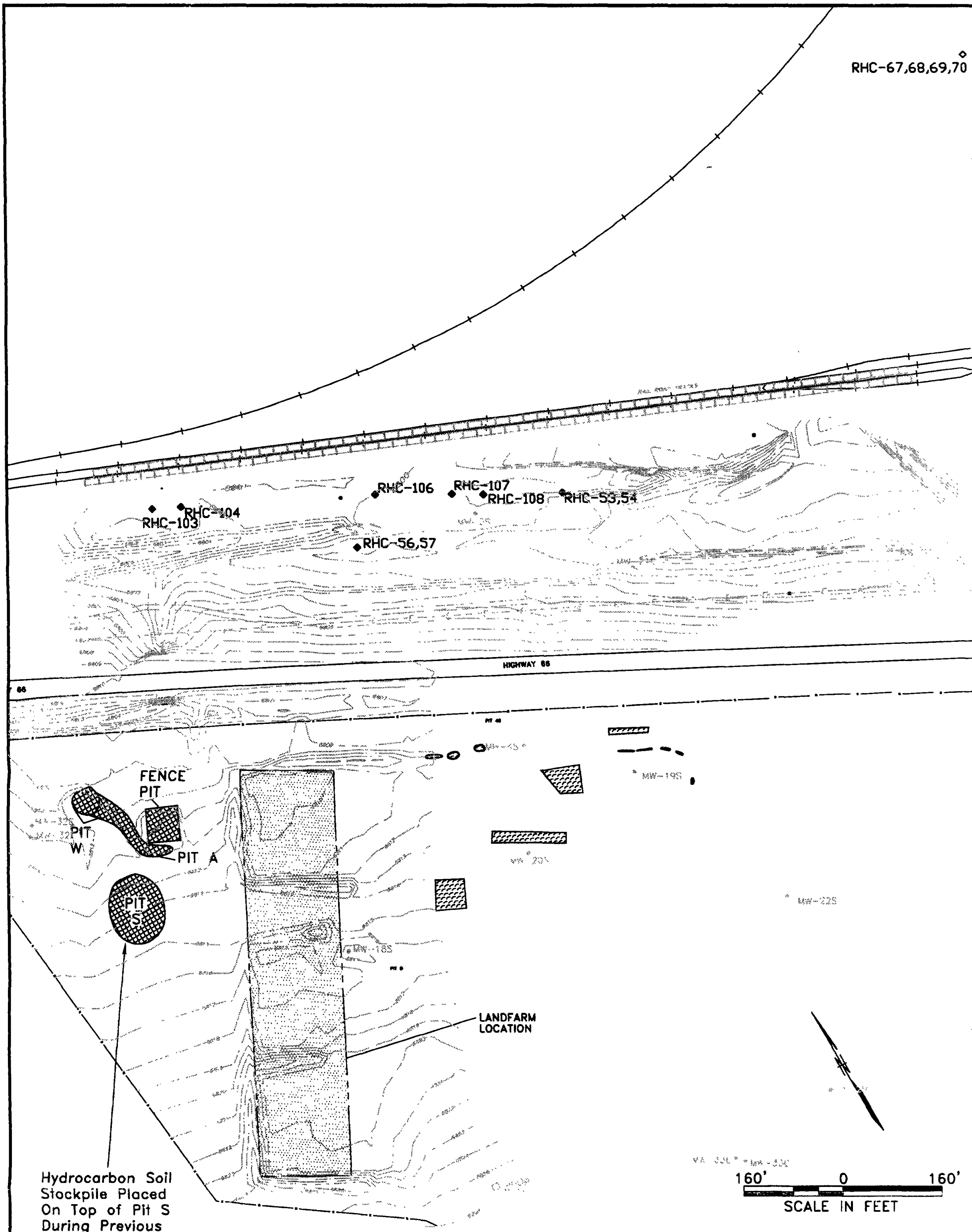
Title Prewitt Refinery Site - RA Construction and Completion Report - Landfarm Remedy Figure 2-1 West Pitts and Hydrocarbon Soil Sampling Locations



Applied Hydrology Associates, Inc.

LEGEND

6819	Pre-Construction Contours
	Landfarm Area
	West Pits
	Hydrocarbon Soils Removed During Previous R.A Activities
◇ RHC-103	Pre-excavation Hydrocarbon Soil Sampling Location

NO.	DATE	REVISION	DRAWN	CHECKED	APPROVED
1	1/97	FINAL		APD	APD

PREWITT REFINERY SITE

PREWITT, NEW MEXICO

RA CONSTRUCTION AND COMPLETION REPORT LANDFARM REMEDY

FIGURE 2-1

WEST PITS AND HYDROCARBON SOIL SAMPLING LOCATIONS

APD	9/29/96	FARMBORD.DWG
AHB	As Shown	
	52-01B	

The total benzo(a)pyrene equivalent ranged from 1.61 to 3.55 ppm, with a mean of 2.66 ppm, which is below the landfarm treatment standard of 4.5 ppm total benzo(a)pyrene equivalent. Therefore, the soil stockpile was used to construct the buffer soil layer. This achieved two purposes:

- It eliminated placement of clean soils in the landfarm and thus reduced the quantity of affected soil, and

- It reduced the depth of soils requiring treatment in the landfarm which promotes more efficient treatment during O&M.

2.2 Contractor Selection

Following EPA approval of the RA Work Plan Addendum for the Landfarm Remedy in February 1996, ARCO/EPNG proceeded with implementation of Landfarm construction. This included contractor selection and project organization. ARCO/EPNG assumed overall project management, financial control, contract management, and interface communication with EPA and NMED. The O&M contractor for the subsurface remedial action, AVM Environmental Services of Grants, New Mexico, was retained to assist ARCO and EPNG's project managers with site management, project coordination, and oversight of the construction of the Landfarm Remedy.

Applied Hydrology Associates, Inc. (AHA), the Supervising Contractor and Quality Assurance Official (SC/QAO), for previous remedial action activities at the Site was retained by ARCO/EPNG to continue as SC/QAO for construction of the Landfarm Remedy. Responsibilities of the SC/QAO include inspecting on-site construction work, securing containers and preservatives for the required laboratory analyses, preparing chain of custody documentation, insuring compliance with the RA Quality Assurance Plan, and reporting and interpreting analysis results from field and laboratory sampling. Technicians from AVM Environmental Services were also retained by ARCO/EPNG to assist the SC/QAO in sampling activities.

Likewise, a Request for Proposal (RFP) soliciting a bid was submitted to three pre-qualified contractors for construction of the Landfarm Remedy. An on-site pre-bid meeting was held on April 10, 1996 for the site walk through and to respond to questions by prospective bidders. ARCO/EPNG selected Harding Lawson Associates (HLA) as the RA Contractor for Landfarm Remedy construction and notified EPA of this selection prior to the Pre-Construction Conference.

2.3 Locating and Sampling of West Pits and Hydrocarbon Contaminated Soils

The locations and volumes of hydrocarbon contaminated soils were determined as part of the RI/FS. The FS estimated the total volume of hydrocarbon-contaminated soil to be about 3,000 cubic yards, including the West Pits and Separator Subsoils. Volume calculations, performed during the FS and used in the RD, utilized historical and recent aerial photographs, site inspections, and soil chemical data from soil sampling performed during the RI.

Hydrocarbon soils from the Office and Separator Areas, including the Separator Subsoils, were excavated during completion of previous RA activities and general debris clean-up at the Site. Although the corresponding volume estimated in the FS for this hydrocarbon soil and Separator Subsoil removal was only about 550 cubic yards, approximately 2,000 cubic yards of hydrocarbon soil were actually removed and temporarily stockpiled during this work. Furthermore, this stockpiled volume did not include the hydrocarbon soils that were removed from these locations and transported off-site with the lead-contaminated soil.

Given these differences, ARCO/EPNG were concerned about potential inaccuracy in the volume of hydrocarbon-contaminated soil remaining to be excavated. Previous delineation is accurate for the West Pits Area, but not very accurate for the Railroad Area and the North Pit Area. The required depth of removal was not identified for these areas. The Landfarm was designed to accommodate 4,000 cubic yards of hydrocarbon-contaminated soil. Landfarm soil volumes in excess of 4,000 cubic yards could reduce the efficiency of treatment, and volumes above 6,000 cubic yards would require additional landfarm area. Since the volume of excavated soil required to achieve the clean-up can be minimized by more extensive sampling and excavation control, delineation of the areas of hydrocarbon-contaminated soil in Railroad and North Pit Areas and sampling prior to start of the RA was conducted to better define the volume of hydrocarbon-contaminated soil and to provide reliable target depths for excavations.

Sampling was conducted on March 11, 1996 at five locations in the Railroad and North Pit Areas, where the Remedial Investigation sampling indicated PAH levels above the action levels. Samples were collected at a depth of two feet below the surface. All samples were sent to ACZ Laboratory for analysis of concentrations of PAHs. The analytical results are provided in Appendix 2.1 and are summarized in Table 2-2. Individual PNAs were converted to benzo(a)pyrene equivalent and added to determine a total benzo(a)pyrene equivalent to compare with the standard.

The benzo(a)pyrene equivalent sum of all PAHs in Table 2-2 ranges from 0.43 for several samples where all PAH concentrations were less than the detection limit to 5.83 ppm for a soil mound near the landfarm area. The soil mound was sampled because it appeared to contain some hydrocarbon materials and it was not sampled during the RI. The results for the soil mound showed PAH content to be above the excavation standard for soils at 0-2 feet depth. Consequently, this soil mound material was included for excavation and landfarm remediation.

Sample RHC 67,68,69,70 was collected at a depth of two feet at the location corresponding with sample SS 67,68,69,70 (DUP) from the North Pit taken during the RI. There was no hydrocarbon-staining at the surface in the vicinity of this sample location and the analysis results at two feet were less than detection.

The remaining samples reported in Table 2-2 were collected at a depth of two feet at locations corresponding to the RI sampling locations in the Railroad Area. Since the results of all the samples from the Railroad Area are less than the excavation standard of 20.6 mg/kg for total benzo(a)pyrene equivalent for all PAHs for soils below two feet from surface, it was concluded that soils in these areas would be excavated based on visual screening. However, excavation would stop at two feet unless confirmatory sampling indicated that the clean-up standard below two feet from the surface was not attained. Excavation based on visual screening was considered conservative since PAHs would not be present without hydrocarbon staining even though hydrocarbon staining does not verify the presence of PAHs.

Table 2-2. PAH Analysis of Hydrocarbon-Contaminated Soil Locations

Railroad and North Pit Areas

	RHC 108 [1]			RHC 107 [1]			RHC 56, 57 [1]			RHC 104 [1]		
PHA	Conc. ppm	Q[2]	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q[2]	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q[2]	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q[2]	Benzo (a)pyrene Equiv., ppm
Benzo(a)anthracene	0.330	U	0.033	0.330	U	0.033	0.330	U	0.033	0.990	U	0.099
Benzo(b)fluoranthene	0.330	U	0.033	0.330	U	0.033	0.330	U	0.033	0.990	U	0.099
Benzo(k)fluoranthene	0.330	U	0.033	0.330	U	0.033	0.330	U	0.033	0.990	U	0.099
Chrysene	0.330	U	0.003	0.330	U	0.003	0.330	U	0.003	0.990	U	0.010
Benzo(a)pyrene	0.330	U	0.330	0.330	U	0.330	0.330	U	0.330	1.500		1.500
TOTAL			**0.43**			**0.43**			**0.43**			**1.81**

	RHC 103, [1]			RHC 53,54 [1]			RHC 67,68,69,70 [1]			Soil Mound		
PAH	Conc. ppm	Q[2]	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q[2]	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q[2]	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q[2]	Benzo (a)pyrene Equiv., ppm
Benzo(a)anthracene	0.330	U	0.033	1.320	U	0.132	0.330	U	0.033	1.980	U	0.198
Benzo(b)fluoranthene	0.330	U	0.033	1.320	U	0.132	0.330	U	0.033	1.980	U	0.198
Benzo(k)fluoranthene	0.330	U	0.033	1.320	U	0.132	0.330	U	0.033	1.980	U	0.198
Chrysene	0.330	U	0.003	1.320	U	0.013	0.330	U	0.003	1.980	U	0.020
Benzo(a)pyrene	0.330	U	0.330	2.700		2.700	0.330	U	0.330	5.300		5.300
TOTAL			**0.43**			**3.11**			**0.43**			**5.91**

[1] Samples from Railroad and North Pit locations taken at a depth of 2 feet.

[2] Q FORMAT:
"U" Indicates compound was not detected
"J" Indicates compound detected < MDL
"B" Indicates compound was found in daily calibration blank

2.4 Pre-Construction Conference

A Pre-Construction Conference was held on May 7, 1996 prior to the start of construction of the remedy. Participants in the Pre-Construction Conference included the ARCO/EPNG Project Managers, the EPA Remedial Project Manager, oversight personnel from the US Army Corps of Engineers (COE), the Site Manager from AVM Environmental Services, the SC/QAO Officer (Applied Hydrology Associates, Inc.), the Project Manager from the selected RA Contractor (HLA), and a representative of Taylor Construction, HLA's Construction Subcontractor. Responsibilities and coordination among all parties involved in the Remedial Action were reviewed. Project issues discussed during the Pre-Construction Conference included the location of construction facilities, health and safety issues, site security, and the proposed construction schedule. July 2, 1996 was set as the target goal for application of all hydrocarbon soils to the landfarm.

During the Pre-Construction Conference for the Landfarm Remedy, the RA Contractor described their proposed alternate to the pug mill specified in the RD for hydrocarbon soil homogenization. According to the RA Contractor, the proposed method for mixing and blending soils by dozing, tilling, and discing would work better for tarry soils at the Site. EPA agreed with the alternate method of homogenization. In addition, flexibility in the application of nutrients before or after placement of homogenized soils in the landfarm was discussed and agreed upon. The need for liners for temporary soil stockpile was discussed. Based on duration of stockpiling and type of soils, it was agreed the synthetic liner was not necessary for soil stockpiles provided that about two inches of soils under the stockpile would be excavated following removal of the stockpiles and treated in the landfarm.

2.5 Construction Mobilization and Start-Up

Construction mobilization started on May 14, 1996 and continued throughout the week. Procurement of the catch basin liner, the geomembrane for berm erosion protection, the geotextile for covering the hay bale berm, and the nutrients to be added to the treated soils was also started during that week. Hall Environmental Analysis Laboratory was retained by the RA Construction Contractor for analysis of soil samples from the homogenized stockpiles. ACZ Laboratories was retained by the SC/QAO for confirmatory sample analysis. Baseline surveying for landfarm construction began on May 20, 1996. Additional surveying to determine hydrocarbon contaminated soil area topography was completed during the same week. Site preparation work for landfarm construction started following the baseline survey.

3.0 SITE PREPARATION AND CONSTRUCTION OF THE LANDFARM

This chapter describes the landfarm site preparation and construction of the landfarm treatment cell, including compaction and testing of the liner, placement of the buffer soil layer, and construction of the irrigation system. Homogenization of contaminated soils and placement in the landfarm treatment cell is described in Chapter 5.

3.1 Remedial Design Requirements

As stated in Volume 4 of the RD Report, the scope of work to construct the landfarm involved the following activities and requirements:

- Prepare the landfarm site, including removing vegetation, rocks and boulders; and excavation to establish grade of approximately 1% and to facilitate landfarm closure.
- Construct berms and a run off and seepage collection basin lined with 40-mil HDPE.
- Install clay liner with a minimum thickness of 6-inches of clay soil from previously characterized borrow area and compacted to at least 95% maximum dry density.
- Confirm compaction of clay liner to at least 95% maximum dry density by field measurements using a sand-cone method (ASTM D-1556) or a nuclear density method (ASTM D-2922).
- Install a soil buffer layer to protect the clay liner with a minimum thickness of 4-inches.
- Install a sprinkler irrigation system adequate to maintain required moisture contents using the Shop Well as the water source.

3.2 Site Preparation for Landfarm Construction

Baseline surveying for landfarm construction began on May 20, 1996. Surveyors from SurvTech, Inc. of Albuquerque, New Mexico, installed cut stakes for excavating native soils down to the required landfarm subgrade. Site preparation work for landfarm construction started following surveying. This work included establishing storm water controls; stripping of vegetation from the laydown area and the landfarm construction location; excavation and fill for landfarm subgrade preparation; and construction of water run on/run off protection berms around the landfarm.

Storm water control was initially accomplished by constructing temporary containment berms around construction locations. Dust control was achieved by applying water to construction locations prior to and during construction.

Since the natural grade at the landfarm location exceeded the design grade, the subgrade was constructed using a cut and fill operation. During subgrade preparation, loose sandy soils were not used for fill materials but were stockpiled separately for mixing with hydrocarbon soils, if necessary, to meet the optimal hydrocarbon loading criteria for placement in the landfarm.

The soil mound and hydrocarbon stained soils, encountered during excavation for subgrade preparation (Photo 3-1), were also segregated and temporarily stockpiled near the West Pits for placement in the landfarm for treatment as shown in Photo 3-2. This soil volume was approximately 125 cubic yards. Confirmatory sampling of the excavation following removal of the hydrocarbon-contaminated soil from the landfarm was not performed for the following reasons:

- there was no visual indication of hydrocarbon remaining in the subgrade of the landfarm, and

- the location where the hydrocarbon-stained soil was removed will be 4 feet below grade following closure of the landfarm.

Photo 3-1. Hydrocarbon-Stained Soils Encountered During Landfarm Subgrade Construction

Photo 3-2 Temporary Stockpile of Hydrocarbon Soils Removed During Landfarm Construction

Initially, the landfarm subgrade was completed by the RA Contractor on May 30, 1996. However, after review of the subgrade elevation survey, it was determined that the final, average elevation of the hydrocarbon-contaminated soils in the treatment cell would not be below the surrounding surface grade. For proper closure of the landfarm, the average elevation of the treatment zone must be below the surrounding topography so that a soil cover can be placed over the treatment zone and graded to match the surrounding topography.

Additional equipment, including scrapers and dozers, were mobilized on June 1, 1996 to excavate the landfarm subgrade to an average elevation of about 3 feet below the surrounding grade to permit in-place closure of the landfarm, in accordance with the RD. This work continued over the weekend to minimize delay in the schedule. Subgrade preparation was completed on June 4, 1996 and the subgrade of the landfarm was surveyed prior to construction of the clay liner. Survey elevations for the final subgrade of the landfarm are provided in Appendix 3.1. The landfarm subgrade has a slope of about 1.25 percent to the north toward the lined run-off collection basin.

Approximately 10,000 cubic yards of soil were excavated during landfarm subgrade preparation The storm water run on/run off protection berms were constructed using these soils and excess soil was placed in a temporary stockpile on the east side of the landfarm as shown in the Photo 3-3. The soils in this temporary stockpile as well as the soil in the landfarm berms will be used for landfarm closure.

Concrete, old refinery piping, and oil stained soils were also encountered when preparing the surface immediately east of the landfarm for the temporary soil stockpile (Photo 3-4). Since the RA sequence was to construct the landfarm first and then to remove hydrocarbon soil, the soils removed during subgrade preparation were stockpiled in an adjacent location and the oil-stained soil and piping was scheduled for removal during hydrocarbon soil excavation work.

Photo 3-3 Temporary Stockpiling of Soils Excavated During Landfarm Subgrade Construction

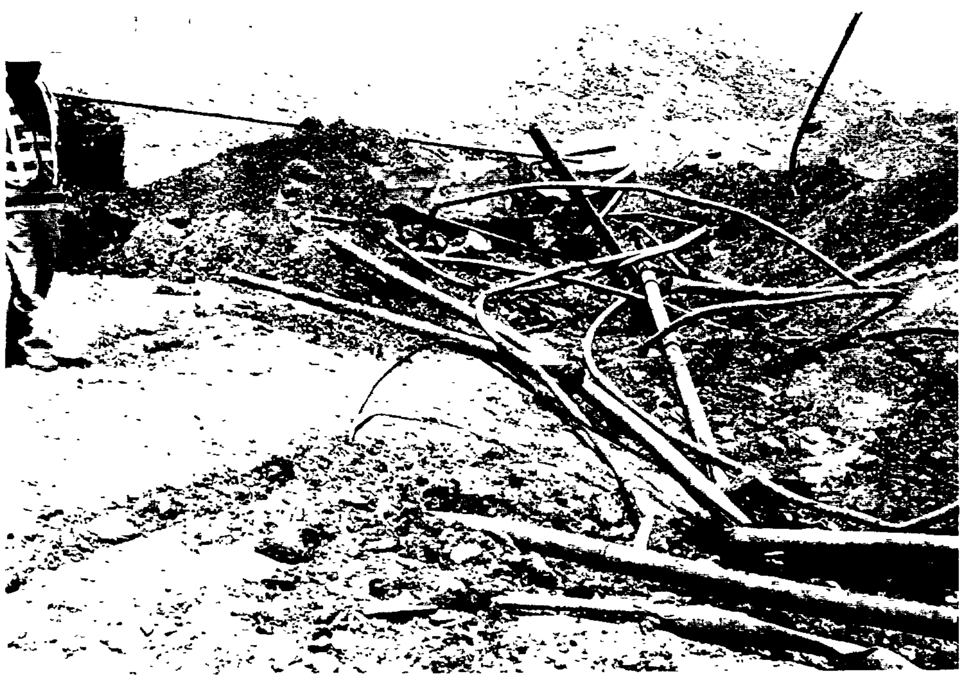


Photo 3-4 Hydrocarbon Soils and Piping Encountered East of the Landfarm

3.3 Construction of the Clay Liner

Construction of the clay liner began on June 4 and was completed on June 10. The clay soil, from the previously characterized borrow area, was used for clay liner construction. Water was applied to the subgrade soils and the surface graded prior to placement of the clay in order to reduce drying (Photo 3-5). During landfarm subgrade preparation, the water production from the Shop Well declined to about 32 gpm which was insufficient to attain optimum moisture during construction of the clay liner. Consequently, an additional water tanker and driver were mobilized to haul water from an off-site source to provide adequate water for clay liner construction and dust control.

A 21.7 percent optimum moisture was specified in the RD based on a standard Proctor compaction test (ASTM D 598-91, Procedure A) of the top 1-foot layer of the borrow area clay soil. Because the top 3-foot layer was to be used for construction of the clay liner, the RA Contractor collected a composite sample from the upper 3 feet of clay soil from the borrow area which was analyzed using the standard Proctor compaction test. These results showed a 24.7 percent optimum moisture for clay soil compaction. These results are provided in Appendix 3.2 along with the results obtained during the RD. In addition, a sieve analysis was conducted on the same three-foot layer, composite sample which indicated that the particle size of the material is similar to the RD sample.

After discussion with EPA's onsite representative it was agreed that a moisture content range of 21.7 to 27.7 percent from the moisture-density curve for the clay soil sample taken by the RA Contractor be used as the target moisture content range to achieve at least 95 percent maximum dry density (MDD). Testing performed for the RD demonstrated that the clay soil from the borrow area compacted to 95 percent MDD will have a permeability of less than $1x10^{-7}$ cm/sec.

The liner was constructed in accordance with the RD. The clay was brought in by truck and spread out in a 9-inch lift with dozers as shown in Photo 3-6. Water was applied and the clay soil disked during placement in the landfarm as shown in the photograph in Photo 3-7 in order to achieve optimum moisture for compaction. The clay liner was compacted using dozers and a sheeps foot roller. Water was applied continuously during compaction of the clay.

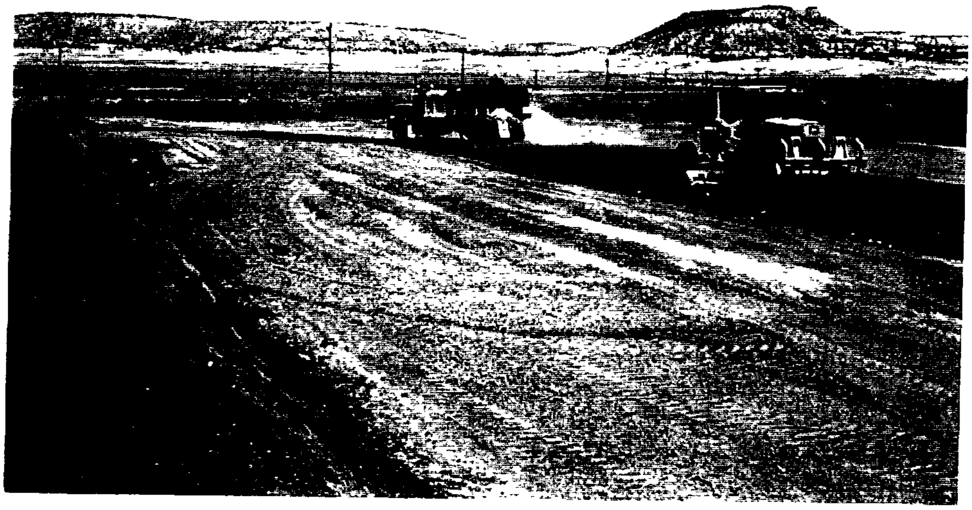


Photo 3-5 Applying Water and Grading Prior to Clay Liner Construction

Photo 3-6 Dozing Clay Layer During Construction of the Liner

Photo 3-7. Applying Water and Disking Clay Soil to Obtain Optimum Moisture

Moisture and compaction testing was conducted during liner construction to demonstrate compliance with RD construction specifications. In one area, where the moisture was outside the optimum range, the liner was ripped as shown in Photo 3-8. Additional moisture was applied using the water truck and the clay was recompacted using a sheeps foot roller as shown in Photo 3-9.

Liner compaction requirements were confirmed using the sand cone test method (ASTM D 1556) in accordance with the RD. However, the RD did not specify the number of compaction tests and the test locations needed for confirmation. After coordination and agreement with the EPA's onsite representative, a total of 12 sand cone tests were conducted at the locations shown on Figure 3-1. The nuclear density gage method (ASTM D-2922) was an alternate test method specified in the RD. To assure sufficient compaction of the clay liner, nine nuclear density gage measurements were also taken in accordance with ASTM D-2922 at random locations over the clay liner as shown in Photo 3-10.

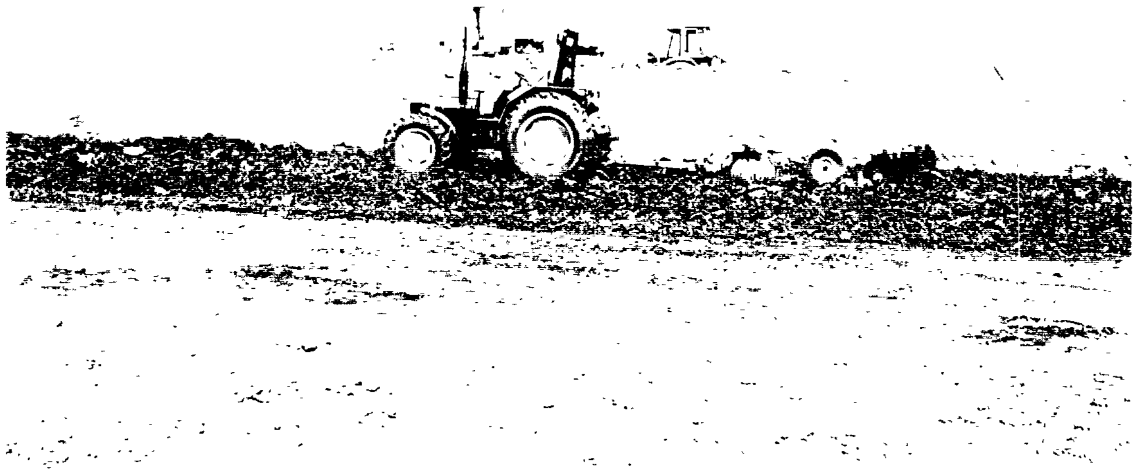


Photo 3-8 Ripping Clay to Apply Additional Moisture for Compaction of the Clay Liner

Photo 3-9 Re-Compaction of the Clay Liner

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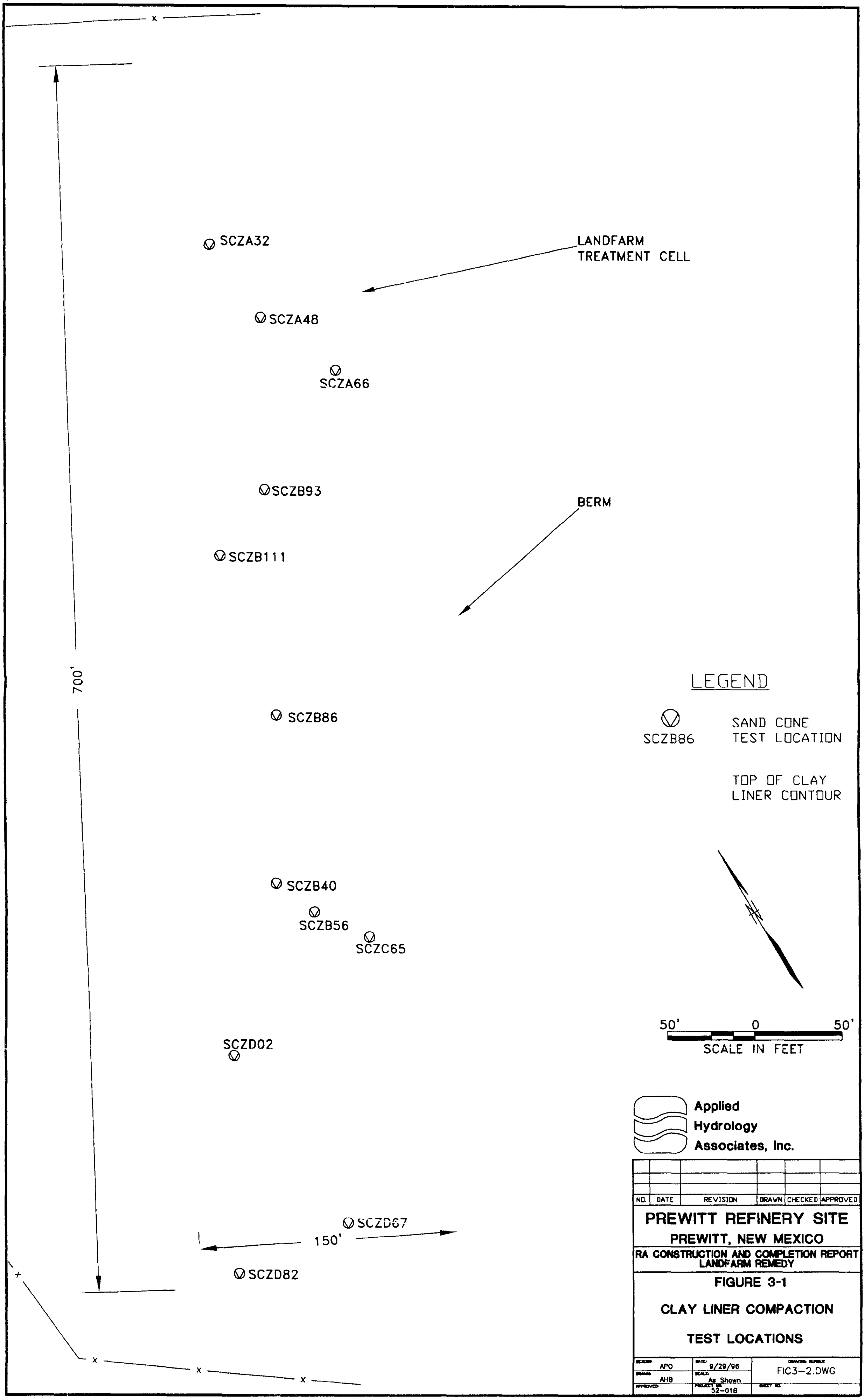
Title Prewitt Refinery Site - Figure 3.1

Clay Liner Compaction Test Locations


SCZA32
LANDFARM
TREATMENT CELL
SCZA48
SCZA66
SCZB93
BERM
SCZB111
700'
LEGEND
SCZB86
SCZB86
SAND CONE
TEST LOCATION
TOP OF CLAY
LINER CONTOUR
SCZB40
SCZB56
SCZC65
50'
0
50'
SCALE IN FEET
SCZD02
Applied
Hydrology
Associates, Inc.
NO.
DATE
REVISION
DRAWN
CHECKED
APPROVED
SCZD67
150'
SCZD82
PREWITT REFINERY SITE
PREWITT, NEW MEXICO
RA CONSTRUCTION AND COMPLETION REPORT
LANDFARM REMEDY
FIGURE 3-1
CLAY LINER COMPACTION
TEST LOCATIONS
APO
9/29/96
FIG3-2.DWG
AHB
As Shown
52-018

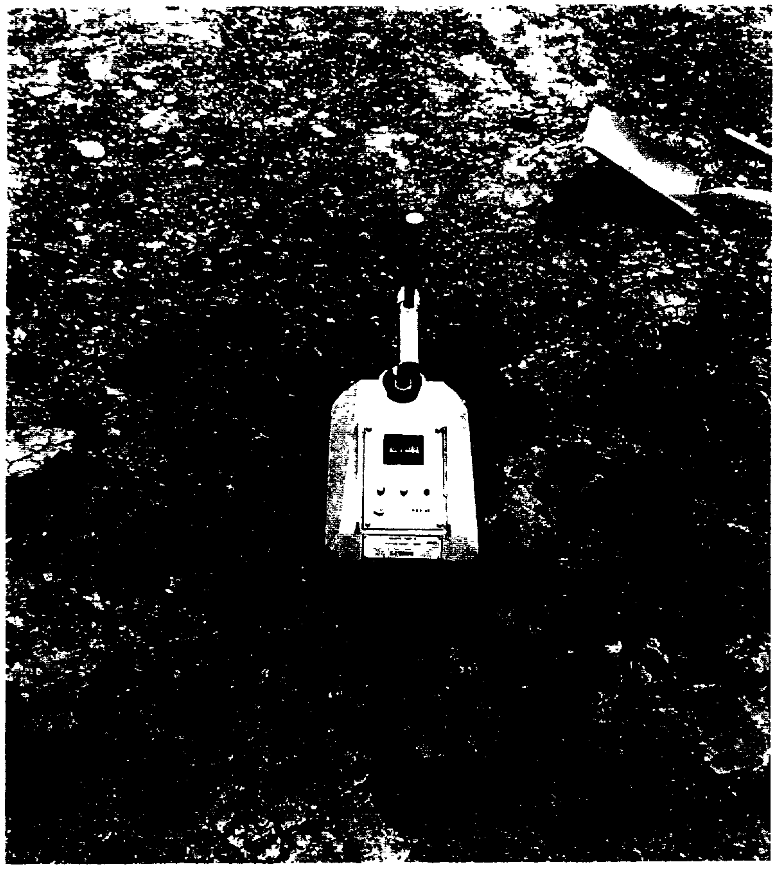


Photo 3-10. Nuclear Density Gage Test of the Clay Liner

The sand cone test involves excavating a hole in the compacted clay liner. To provide additional verification of liner thickness, the thickness at each test location was measured as shown in Photo 3-11. The "in situ" dry density of the liner material was determined from the sand cone test procedure (ASTM D 1556) applied in the field as shown in Photo 3-12.

The results of the sand cone tests are provided in Appendix 3.3 and are summarized in Table 3-1. The "in-situ" dry density determined from the sand cone test was divided by the maximum dry density from the standard Proctor test of the upper three-feet of borrow area soils to determine the percent compaction. The results of the nuclear density gage measurements taken at 9 different locations are also provided in Appendix 3.3 and are summarized in Table 3-2. The results of both testing procedures demonstrated that the liner was compacted in accordance with the RD to a minimum of 95 percent of MDD.

Photo 3-11. Measurement of Clay Liner Thickness at Sand Cone Test Hole

Photo 3-12. Sand Cone Compaction Test of Clay Liner

Table 3-1. Results of Sand Cone Tests

Number	Test Number	Wet Density lb/ft^3	% Moisture[1]	Dry Density[2] lb/ft^3	% MDD Compaction[3]
1	SCZD82	122.9	21.44	101.2	104.7
2	SCZD67	115.0	23.65	93.0	96.2
3	SCZD02	120.8	21.31	99.6	103.0
4	SCZC65	124.5	23.56	100.8	104.2
5	SCZC56	114.9	21.11	94.9	98.1
6	SCZC46	116.6	24.15	93.9	97.1
7	SCZA48	122.4	24.84	98.1	101.4
8	SCZB93	122.2	26.41	96.7	99.96
9	SCZA32	123.6	25.64	98.4	101.7
10	SCZB86	123.0	27.21	96.7	100.0
11	SCZB11	119.6	26.75	94.3	97.5
12	SCZA66	119.0	26.27	94.2	97.4
Average					100.1

Table 3-2. Nuclear Density Gage Measurement Results

Number	Test Location	Wet Density lb/ft^3	% Moisture[1]	Dry Density[2] lb/ft^3	% MDD Compaction[3]
1	550'N, 20'W	114.7	24.4	92.2	95.2
2	450'N, 10'E	117.1	25.4	93.35	96.4
3	375'N, 100'E	122.9	22.5	100.3	103.6
4	W Side, Center	115.55	20.7	95.7	98.9
5	NW Corner	119.5	26.1	94.75	97.9
6	85'S of N End, Center	117.9	23.1	95.8	99
7	W Side, N of Center	121.4	26.5	96	99.2
8	SW Corner	114.8	24.8	92	95
9	NE Corner	123.5	24.7	99.25	102.5
Average					98.6

[1] % Moisture = weight of water/ weight of dry soil. (Optimum Moisture = 24.7%)

[2] Dry Density = 100[Wet Density/(% moisture+100)]

[3] Maximum Dry Density = 96.7 lb/ft^3

Elevation surveys were performed prior to and following clay liner construction and are reported in Appendix 3.1. These results together with the clay liner thickness measured at each sand cone test location show that the liner thickness exceeded the minimum of six inches specified in the RD.

A four-inch native soil buffer layer was placed above the clay liner on June 12 and 13. The soil buffer layer was installed in accordance with the RD to avoid damaging the clay liner during O&M tilling activities. The buffer layer was constructed with previously stockpiled soil as discussed in Chapter 2 of this report. Elevation surveys were performed prior to and following placement of the buffer layer. Additional soils were brought in until more than four-inches of soil were above the clay layer. The final survey results, which are also provided in Appendix 3.1, confirm that the buffer layer thickness exceeded the minimum thickness of four inches specified in the RD.

3.4 Run-on/Run-off Control

The storm water run on/run off protection berms were constructed using native soils excavated during landfarm subgrade preparation. The berms were constructed in accordance with the RD with 1:1 side slopes and a 3-foot top width as shown in the Photo 3-13. A geomembrane, Dura Skim 12WW, was selected for erosion control on the water run-on/run-off protection berms. This material was approved by ARCO/EPNG and EPA oversight (See material cut-sheet provided in Appendix 3.4).

A lined storm water and seepage water collection basin was constructed at the toe of the treatment cell at the north end of the landfarm as specified in the RD. The purpose of the lined basin is to collect and store storm run off and seepage from the landfarm until it evaporates. The storm water collection basin was lined with 40 mil High Density Polyethylene (HDPE) liner. The HDPE liner was installed over the north end of the compacted clay liner and then compacted clay was installed on top of the clay as shown in Photo 3-14. This created a sealed surface between the collection basin HDPE liner and the landfarm clay liner.

Photo 3-13. Construction of Run-on/Run-off Protection Berm

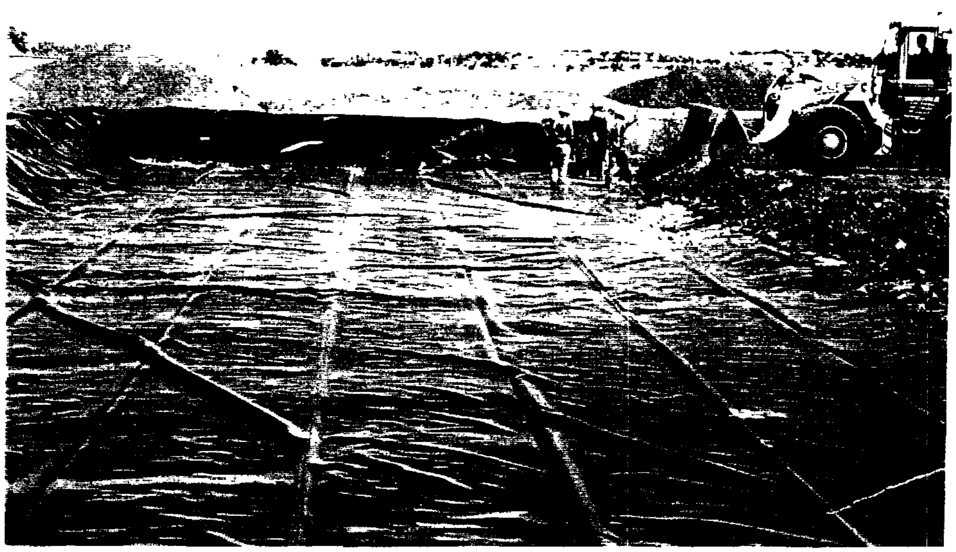


Photo 3-14. Installation of HDPE Liner in Run-off Collection Basin

The hay bale berm was installed across the toe of the landfarm at the entrance to the collection basin as shown in Photo 3-15. The purpose of the hay bale berm is to prevent transport of landfarm soils into the collection basin during storm run off and to allow run off and seepage of any saturated flow above the clay liner to freely drain into the collection basin. The hay bale berm was covered with a nonwoven needlepunched geotextile, 180 EX from American Excelsior (See material cut-sheet provided in Appendix 3.4). This geotextile was approved by ARCO/EPNG and EPA oversight for covering the hay berm. The collection basin construction was completed on June 19, 1996.

3.5 Construction of the Sprinkler/Irrigation System

Landfarm sprinkler system was constructed in accordance with the RD. Construction was started on June 24 and was completed on July 9, 1996. A ditch witch was used to dig an 18-inch deep trench along the top of the landfarm berm and between the landfarm berm and the Shop Well. The 2-1/2 inch Schedule 40 PVC distribution pipe was installed in the trench. In the trench segment between the Shop Well and the landfarm berm the PVC pipe was installed in a 4-inch steel carrier pipe for protection. After the pipes and stick-up for sprinkler heads were installed and the landfarm clay liner and buffer layer were in place, the berms were covered with the Dura Skim 12 WW geomembrane for erosion protection as shown in Photo 3-16.

Eight sprinkler heads with 180° rotation and one with 90° rotation were installed at the locations shown in Figure 3-2. Each sprinkler provides a flow of 34 gpm with a 76 foot spray radius under an operating pressure of 70 psi. The design for the sprinkler irrigation system was based on an assumed water production from the Shop well of 75 gpm at 87 psi which would permit simultaneous operation of two sprinkler heads. During landfarm construction it was discovered that the existing single phase Shop Well pump was incapable of approaching 75 gpm at 87 psi. Therefore, a 5,000 gallon storage tank with a 10 HP booster pump was installed next to the shop well to provide water at the flow and pressure needed to irrigate simultaneously from two sprinkler heads.

Photo 3-15. Hay Berm Installation at Toe of Landfarm Treatment Cell

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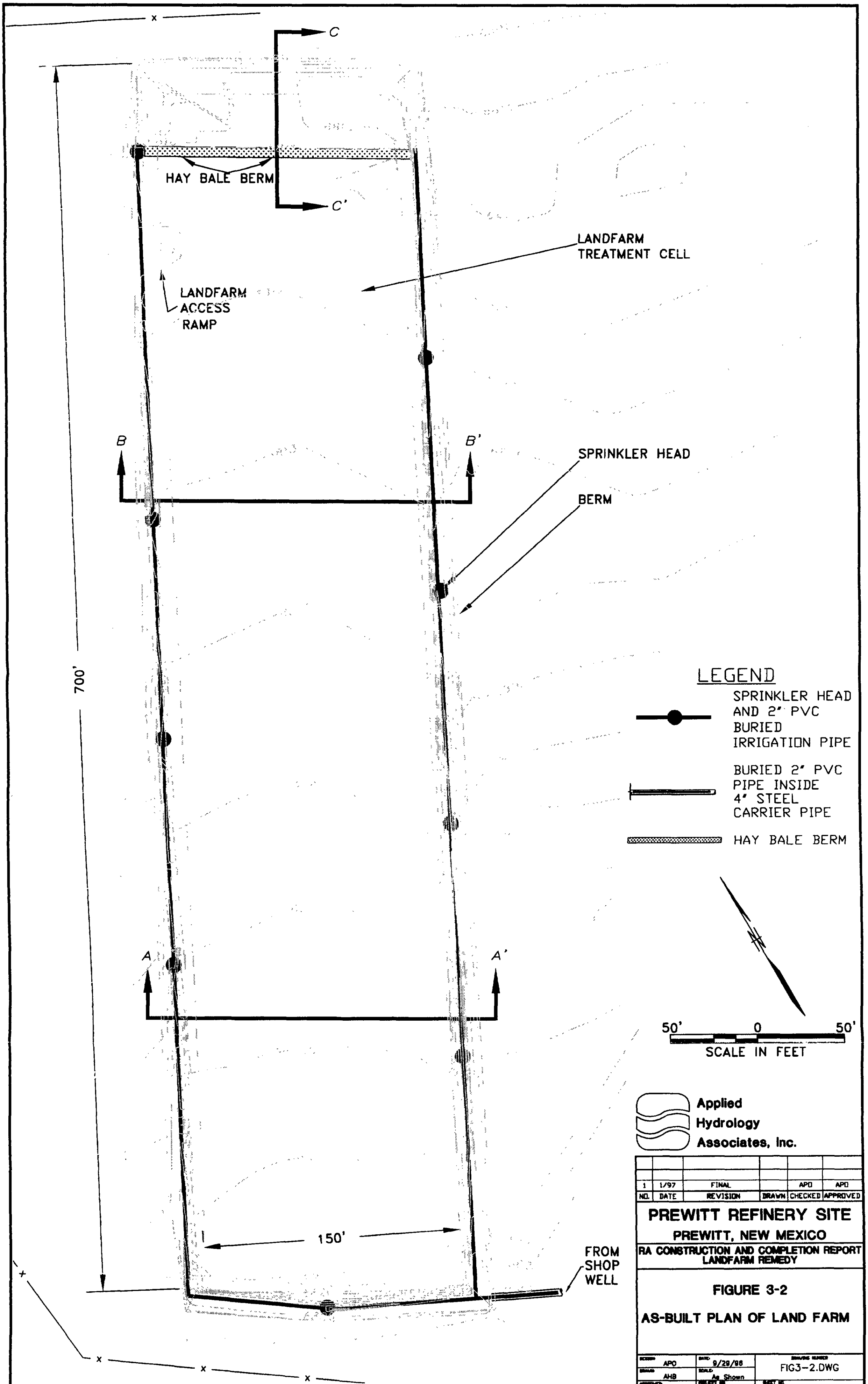
Title Prewitt Refinery Site - RA Construction and Completion Report-Landfarm Remedy - Figure 3-2 AS-Built Plan of Land Farm


C
C'
HAY BALE BERM
LANDFARM TREATMENT CELL
LANDFARM ACCESS RAMP
B
B'
SPRINKLER HEAD
BERM
700'
LEGEND
SPRINKLER HEAD AND 2" PVC BURIED IRRIGATION PIPE
BURIED 2" PVC PIPE INSIDE 4" STEEL CARRIER PIPE
HAY BALE BERM
A
A'
50'
0
50'
SCALE IN FEET
Applied Hydrology Associates, Inc.
1
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APPROVED
PREWITT REFINERY SITE
PREWITT, NEW MEXICO
RA CONSTRUCTION AND COMPLETION REPORT
LANDFARM REMEDY
FIGURE 3-2
AS-BUILT PLAN OF LAND FARM
150'
FROM SHOP WELL
APD
AHB
9/29/96
As Shown
52-018
FIG3-2.DWG

3.6 "As Built" Construction of the Landfarm

A plan drawing of the constructed landfarm is provided in Figure 3-2. This drawing shows the layout of the sprinkler irrigation system, the landfarm berms, the collection basin and hay berm, and the final topography of the landfarm following placement of the soils in the landfarm for treatment. The sections through the landfarm at the locations shown on Figure 3-2 are provided in Figure 3-3. These sections show the subgrade, top of clay liner, top of buffer layer and top of treatment zone for the landfarm and the construction of the hay bale berm and lined run off collection basin. These sections were based on the civil surveys provided in Appendix 3.1.

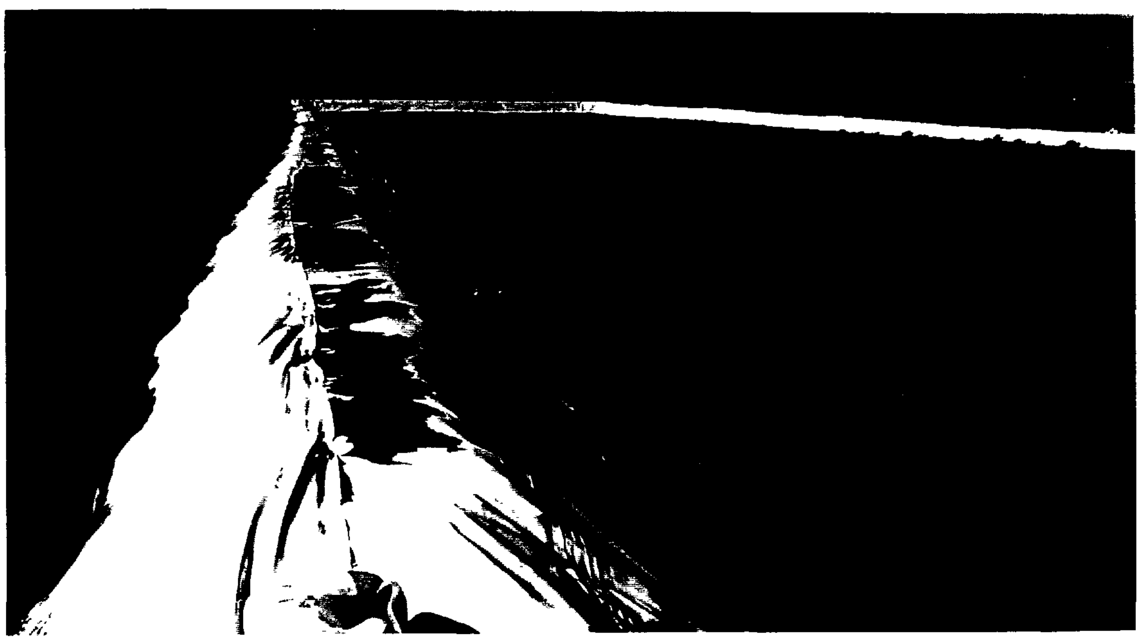

Photo 3-16. Geomembrane for Erosion Protection of Landfarm Berm

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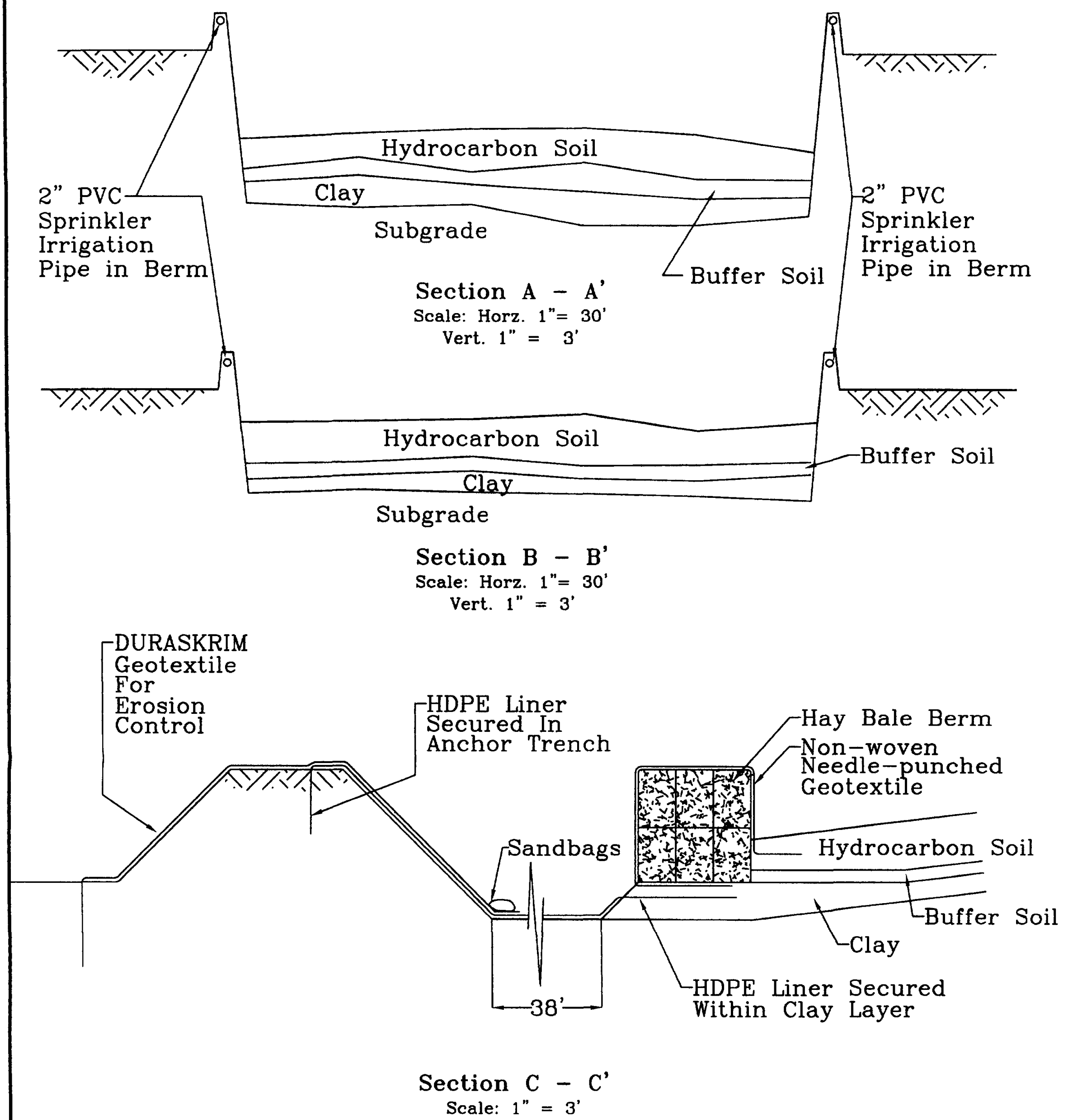
Title Prewitt Refinery Site - RA Construction and Completion Report - Landfarm Remedy - Figure 3.3 Landfarm Sections



Notes:
1. See Figure 3–2 For Section Locations
2. Sections A–A' & B–B' Based on Survey Data Included In Appendix 3.1
3. Section C–C' Based on Field Measurements

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FIGURE 3-3
LANDFARM SECTIONS

SM | SM | 9/30/96 | As Shown | 52-018 | FARMSEC1.DWG

4.0 EXCAVATION OF HYDROCARBON-CONTAMINATED SOILS

The excavation of hydrocarbon-contaminated soil was implemented in accordance with the RD and the RA Work Plan. The remedial objective for excavation of hydrocarbon-contaminated soils and West Pits was to eliminate potential exposure via ingestion, inhalation, or direct content with contaminants. The contaminants of potential concern for the hydrocarbon-contaminated soil and the West Pits are the carcinogenic PAHs. The excavation of hydrocarbon-contaminated soils and the West Pits was conducted in accordance with the RD to meet the clean-up standards summarized in Table 1-1 and described below in Section 4.1. This chapter includes the results of confirmatory sampling which demonstrate that the clean-up standards were attained at the hydrocarbon-contaminated soil and West Pits locations.

This chapter also describes the excavation and stockpiling of West Pits contents and hydrocarbon-contaminated soils and includes estimates of the volume of excavated soils and wastes. The excavation and temporary stockpiling of hydrocarbon soils encountered during previous activities at the Site was addressed in Chapter 2. These hydrocarbon soils were placed in a temporary stockpile in order to complete remedial action and debris removal work at the Site in 1995.

4.1 Remedial Design Requirements

As stated in Volume 4 of the RD Report, the scope of work to meet the remedial objectives for the excavation of hydrocarbon-contaminated soils includes the following tasks:

- Field locate areas previously identified with hydrocarbon contamination.
- Excavate and stockpile hydrocarbon contaminated soils.
- Perform post-excavation confirmatory sampling of all hydrocarbon soil excavations of less than 4 feet in depth to verify removal of hydrocarbon contaminated soils. Analyze confirmatory samples using EPA Method 8270.

- Perform additional excavation and confirmatory sampling, as necessary, if confirmatory sampling of an excavation indicates greater than 0.9 ppm benzo(a)pyrene equivalents for any excavations less than 2 feet in depth or greater than 20.3 ppm benzo(a)pyrene equivalents for any excavations from 2 to 4 feet deep.

- Perform backfill, grading and revegetation of the excavated areas.

4.2 Field Location of Previously Identified Hydrocarbon-Contaminated Soils

During the RI, the locations and volumes of hydrocarbon contaminated soils were determined from historical and recent aerial photographs, site inspections, and soil chemical data from sampling. The hydrocarbon soils in the Separator Area and Office Area were excavated during previous RA activities conducted during 1995 as described in Chapter 2. The remaining hydrocarbon-contaminated soils identified in the RI and RD were field located in March and April of 1996 prior to the start of excavation. The West Pits were readily identified in the field and the perimeter of each pit was evident from the pit berms as shown for the Fence Pit in Photo 4-1.

Photo 4-1. The Fence Pit Prior to Excavation

The hydrocarbon-contaminated soil in the North Pit was not evident in the field. Furthermore, the hydrocarbon-contaminated soil in the Railroad Area was difficult to identify without first locating the RI sampling points. Therefore, the RI sampling points were re-established by surveying and the locations were staked and identified by the RI sampling point designation. The perimeter of the hydrocarbon soil in the vicinity of these sampling locations in the Railroad Area was marked with spray paint in the field based on visual screening.

Sampling of the identified hydrocarbon-contaminated soils in the Railroad and North Pit Areas was performed, as described in Chapter 2, to provide target depths for excavation. Surveying was also performed to determine the surface elevations and topography in hydrocarbon contaminated soil areas. The pre-excavation topography and the hydrocarbon soil sampling locations were shown in Figure 2-1.

4.3 Excavation of Hydrocarbon Contaminated Soils

Excavation of hydrocarbon contaminated soils from both the Railroad Areas and the West Pits started on June 13th and was completed on June 26th. An exclusion zone was established around the excavation areas prior to the start of excavation. A variety of equipment, including dozers, track hoes, back hoes, and scrapers, was used for excavation depending upon the dimensions of the pit or hydrocarbon soil area, the target depths of excavation, and the nature of the material excavated.

Hydrocarbon-contaminated soils in all the West Pits locations were initially excavated to the target depth of two feet. The Fence Pit, the A Pit, and one location in the S Pit were excavated to a depth of four feet because hydrocarbon sludge was found at depths below two feet. Drill cuttings and dry hydrocarbon soil from the landfarm construction were blended with wastes in the Fence Pit, prior to and during excavation, to adsorb water and oil which helped facilitate excavation with a track hoe as shown in Photo 4-2. This also helped in the subsequent stage of soil homogenization.

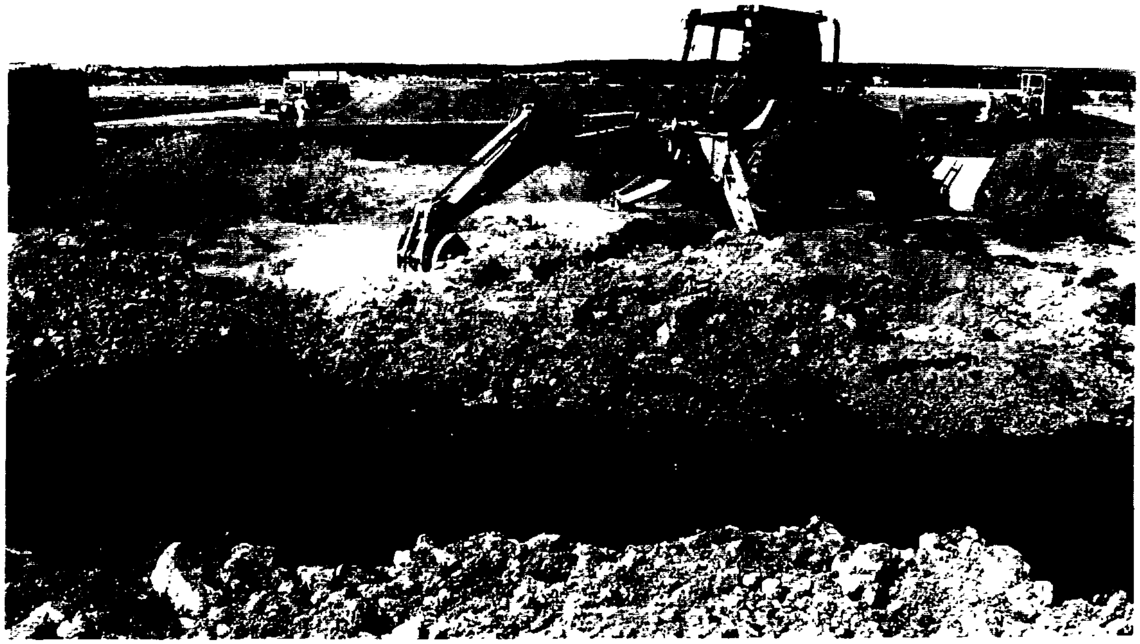

Photo 4-2. Excavation of The Fence Pit

Surface hydrocarbon soils in the Railroad Area were excavated to a depth of two feet. A viscous tar found at the surface adjacent to these excavations was removed by excavating the soils to a depth of about six inches, even though the tar was unrelated to the hydrocarbon-contamination discovered during the RI.

Additional hydrocarbon soils were encountered and removed from three areas which were not identified in either the RI or the RD Report. These locations were:

- The waste pit (Pit 4S in Figure 4-1) located west of Well MW-4S
- An area east of the landfarm (Pit D in Figure 4-1) where piping and oil-stained soils were encountered, and
- The soil mound and hydrocarbon-stained soil in the landfarm location.

The soil mound in the landfarm was completely removed prior to start of subgrade preparation. Also, the hydrocarbon-stained soils, encountered during landfarm subgrade construction, were completely removed and the final grade was inspected by the SC/QAO and EPA oversight.

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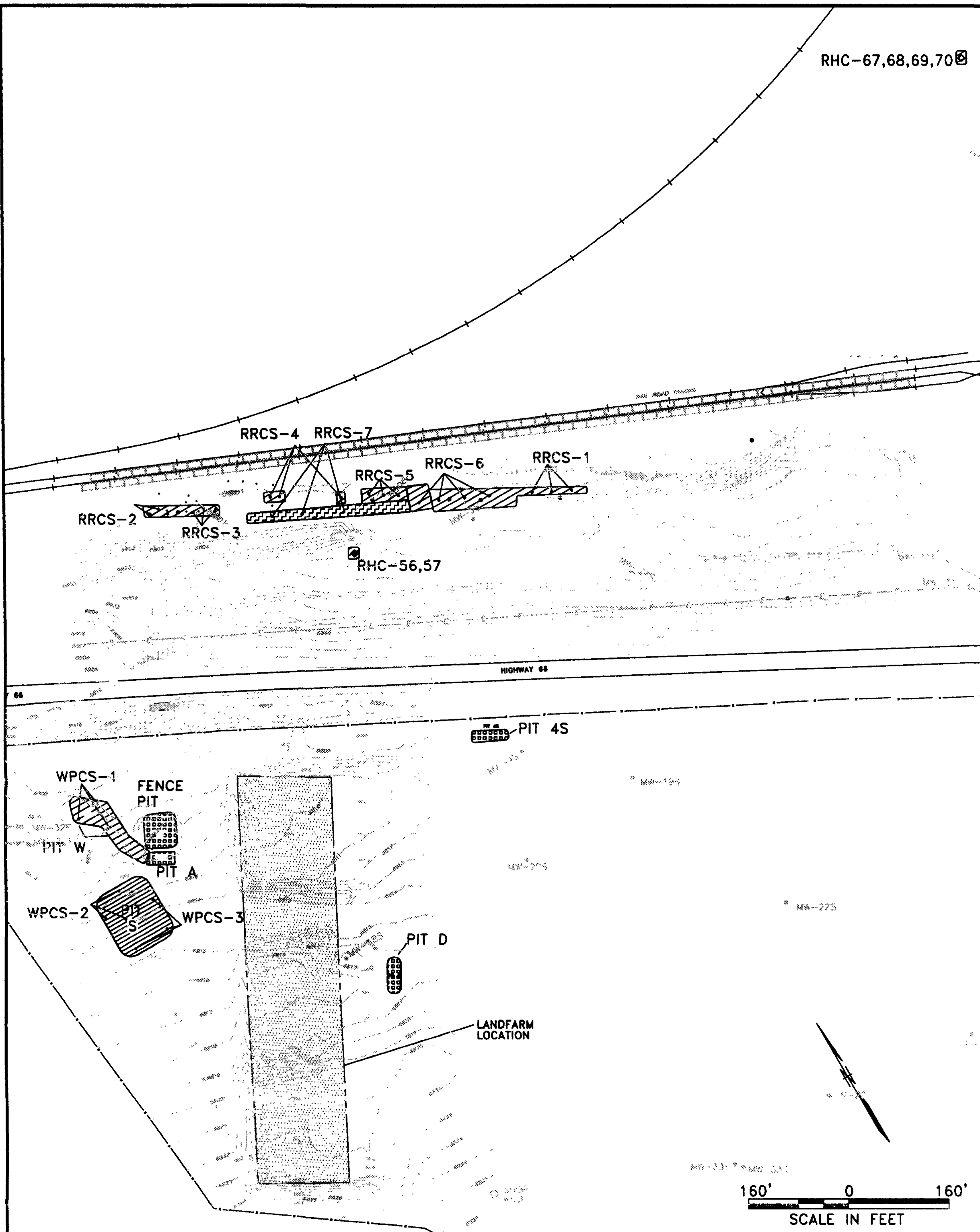
Title Prewitt Refinery Site - R.A. Construction and Completion Report Landfarm Remedy - Figure 4.1 West Pits and Hydrocarbon Soil Excavations and Confirmatory Sampling Locations



LEGEND

6819 Pre-Construction Contours

Hydrocarbon Soil Excavations

< 2 Feet BGS

2 – 4 Feet BGS

> 4 Feet BGS

- RRCS-1 Confirmatory Sampling Location
- WPCS-1 Confirmatory Sampling Location
- RHC-56,57 Hydrocarbon Soil Sampling Location (2 ft. BGS, Pre-excavation)

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FIGURE 4-1
WEST PITS AND HYDROCARBON SOIL EXCAVATIONS AND CONFIRMATORY SAMPLING LOCATIONS

APO	9/29/96	FARMBORD.DWG
AHB	As Shown	
	52-018	

No evidence of hydrocarbon staining was observed in the landfarm subgrade. The hydrocarbon soils in Pit 4S and Pit D were removed and the excavated to four feet.

During excavation and stockpiling of hydrocarbon-contaminated soils, water was applied by a water truck and sprayed to minimize fugitive dust emission as shown in Photo 4-3. Excavated soils were transported to a staging area located in the West Pits Area where soils were homogenized and placed in temporary stockpiles as described in Chapter 5.

During excavation of hydrocarbon contaminated soils in the Railroad Area, suspected asbestos containing materials (ACM) were encountered adjacent to an excavation. The ACM at this location was immediately stabilized by an onsite trained technician by covering it with plastic sheeting. The RA Contractor subcontracted with Keers Environmental, an asbestos abatement contractor, and arrangements were made to remove, transport, and dispose the ACM at the Keers facility in Mountainaire, New Mexico. The Waste Manifest for ACM disposal is provided in Appendix 4.1. Confirmatory sampling of the soil was performed following removal of the ACM. The results of the ACM analysis included in Appendix 4.1 demonstrate that the ACM was removed in compliance with the ACM clean-up criteria and procedures specified in the RD.

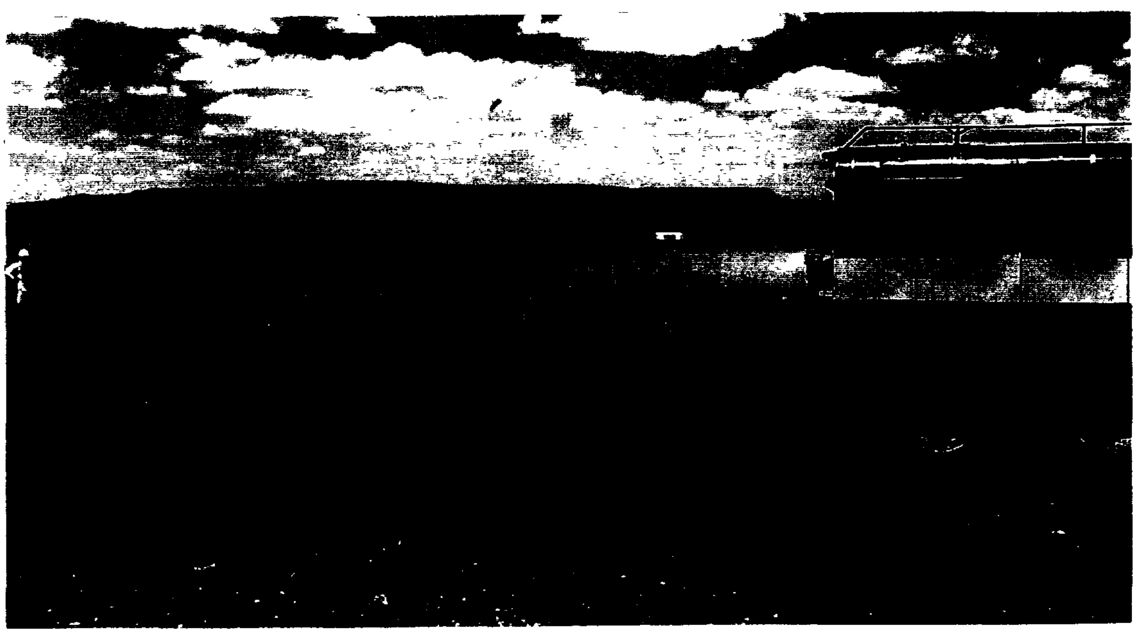

Photo 4-3. Water Spraying for Dust Control During Excavation of West Pits

Following excavation of the hydrocarbon-contaminated soil at the Site, the excavations were visually inspected by the SC/QAO and the depth of the excavation was measured. Deeper excavation was performed where it appeared that any remaining hydrocarbon-contamination could cause interference with the laboratory analysis for PAHs such that the detection limits for the PAHs could be above the clean-up standard. After the excavation of contaminated soil was completed in a given area, the depth of the excavation was measured and composite confirmatory samples were collected at all hydrocarbon soil excavations of less than 4 feet in depth, as described in the next section.

4.4 Confirmatory Sampling of Hydrocarbon Contaminated Soil Excavations

Upon completion of excavation activities, confirmation sampling was conducted in accordance with the RA Sampling Plan in all areas which were excavated to a depth of less than four feet. Three point composite samples were collected from auger samples taken from the upper four inches on 30 foot spacing. Composite samples were analyzed for PAHs by ACZ Laboratory using EPA Method 8270. The analytical results from confirmatory sampling are provided in Appendix 4.2. A split of sample WP-CS2 was taken for quality assurance.

Confirmatory sampling was performed at all the excavations in the Railroad Area and the West Pits of less than 4 feet in depth. The analytical results calculated benzo(a)pyrene equivalents, and total benzo(a)pyrene equivalents from confirmatory sampling are summarized in Table 4-1. In Table 4-1, the reported PAH concentrations were converted to benzo(a)pyrene equivalents based on a relative potency to benzo(a)pyrene of 0.1 for benzo(a)anthracene, benzo(b)fluoranthene, and benzo(k)fluoranthene and of 0.01 for chrysene. The benzo(a)pyrene equivalent for each constituent was added to compute a total benzo(a)pyrene equivalent which was then compared to the clean-up standards. For concentrations reported as less than detection limit ("U" qualified), the concentration was assumed to be the detection limit. Since "U" qualified results were found in all the samples, the calculated total benzo(a)pyrene equivalents are conservative (the actual total benzo(a)pyrene equivalent is less than the calculated value).

Table 4-1. Results of Confirmatory Sampling of Hydrocarbon Soil Excavations

West Pits and Railroad Areas

	WP-CS1[1]			WP-CS2[1]			WP-CS3[1]			RR-CS1[1]			RR-CS2[1]		
PAH	Conc. ppm	Q[3]	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q[3]	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q[3]	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q[3]	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q[3]	Benzo (a)pyrene Equiv., ppm
Benzo(a)anthracene	0.990	U	0.099	0.540	J	0.054	0.800		0.080	4.600		0.460	0.330	U	0.033
Benzo(b)fluoranthene	0.990	U	0.099	0.990	U	0.099	0.660	U	0.066	0.330	U	0.033	0.330	U	0.033
Benzo(k)fluoranthene	0.990	U	0.099	0.990	U	0.099	0.660	U	0.066	0.330	U	0.033	0.330	U	0.033
Chrysene	0.990	U	0.010	1.100		0.011	2.000		0.020	6.200		0.062	0.330	U	0.003
Benzo(a)pyrene	0.990	U	0.990	0.850	J	0.850	1.400		1.400	7.200		7.200	0.330	U	0.330
TOTAL			1.30			1.11			1.63			7.79			0.43

	RR-CS3[1]			RR-CS4[1]			RR-CS5[1]			RR-CS6[1]			RR-CS7[2]		
PAH	Conc. ppm	Q[3]	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q[3]	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q[3]	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q[3]	Benzo (a)pyrene Equiv., ppm	Conc. ppm	Q[3]	Benzo (a)pyrene Equiv., ppm
Benzo(a)anthracene	1.100		0.110	8.600		0.860	4.900		0.490	2.300	J	0.230	0.330	U	0.033
Benzo(b)fluoranthene	0.330	U	0.033	3.300	U	0.330	0.330	U	0.033	3.300	U	0.330	0.330	U	0.033
Benzo(k)fluoranthene	0.330	U	0.033	3.300	U	0.330	0.330	U	0.033	3.300	U	0.330	0.330	U	0.033
Chrysene	2.100		0.021	11.000		0.110	0.330	U	0.003	2.100	J	0.021	0.330	U	0.003
Benzo(a)pyrene	0.330	U	0.330	1.100	J	1.100	9.300		9.300	2.100	J	2.100	0.330	U	0.330
TOTAL			0.53			2.73			9.86			3.01			0.43

1 Samples from excavations in Railroad and West Pits at depths greater than 2-feet.

2 Sample from excavation in Railroad Area at a depth of 6-inches.

3 Q FORMAT: "U" Indicates compound was not detected
"J" Indicates compound detected < MDL
"B" Indicates compound was found in daily calibration blank

Excavations of the West Pits and associated confirmatory sampling locations are shown in Figure 4-1. On June 19, 1996, a composite soil sample (WP-CS1) was taken following excavation of more than two feet of hydrocarbon soils from Pit W in the West Pits area. On June 24, 1996, two composite soil samples (WP-CS2 and WP-CS3) were taken following excavation of more than two feet of hydrocarbon soils from the large Pit S in the West Pits area. The calculated total benzo(a)pyrene equivalent from confirmatory sampling in the West Pits excavations ranged from 1.11 to 1.63 ppm. Since all the excavation of the West Pits was extended to a depth of at least two feet, these results confirm that the hydrocarbon-contaminated soil in the West Pits was excavated to meet the 20.3 ppm total benzo(a)pyrene equivalent clean-up criteria.

Excavations in the Railroad Area and associated confirmatory sampling locations are also shown in Figure 4-1. Composite samples RR-CS1 through RR-CS6 were taken following excavation of more than two feet of soil from these hydrocarbon soil excavations as shown in Photo 4-4. The calculated total benzo(a)pyrene equivalent from confirmatory sampling in the excavations of greater than two feet in depth in the Railroad Area ranged from 0.43 (all concentrations less that detection) to 9.83 ppm. These results confirm that the excavation of hydrocarbon soil in the Railroad Area met the 20.3 ppm total benzo(a)pyrene equivalent clean-up criteria.

Photo 4-4. Confirmatory Sampling of Hydrocarbon Soil Excavation in Railroad Area

The composite sample RR-CS7 was taken from areas adjacent to the hydrocarbon soil excavations where the upper 6-inches of soil was excavated to remove viscous tar (unrelated to the hydrocarbon-contaminated soil) from the surface. The total benzo(a)pyrene equivalent result of 0.43 (all concentrations less that detection) for sample RR-CS7 confirm that the excavation of about 6-inches of soil to remove surface tar within the Railroad Area met the clean-up level of 0.9 ppm total benzo(a)pyrene equivalent for surface soils (less than two feet in depth).

Since the initial confirmatory sample analyses results found that the total benzo(a)pyrene equivalent met the applicable clean-up levels, no additional excavation was required. Excavation and confirmatory sampling activities were coordinated with and observed by the EPA's onsite representative.

Confirmatory sampling was not required or performed at the following excavations where soils were removed to depths greater than 4 feet since there is no action level for hydrocarbon soil below 4-feet:

- The location within Pit S where excavation was extended to depths greater than 4 feet,
- The Fence Pit,
- Pit "A" adjacent to the Fence Pit,
- Pit 4S near monitoring Well MW-4S, and
- Pit D where pipes, concrete, and oil-stained soils were encountered during construction (see Chapter 3).

Most of pipes encountered at excavation D were dry. A few pipes contained some oily material which was removed prior to off-site disposal of the pipes. The oily material was drained onto oil-contaminated soils which were subsequently excavated and mixed with soils placed in the landfarm. The pipes were shipped as non hazardous waste to the Waste Management of New Mexico disposal facility in Rio Rancho. The manifest for waste shipment is included in Appendix 4.4.

4.5 Backfilling of Excavations

After discussion of confirmatory sampling results and inspection of the excavations with EPA oversight personnel, the hydrocarbon-contaminated soil excavations were backfilled with clean soil from the landfarm subgrade excavation clean soil stockpile. Photo 4-5 shows the Fence Pit excavation backfilled with clean soil (see Photo 4-1 for pre-excavation comparison).

The RA Contractor surveyed these excavations to demonstrate backfill to the original elevation. Pre-excavation topographic contours and final backfill elevations are shown on Map 4-1 (in the Map Pocket at the end of this Report) for verification of backfill. The small isolated backfill areas, such as the North Pit, Pit 4S and D Pit, were not surveyed but were observed to be backfilled to the surrounding surface as shown in Photo 4-6 of the backfilled Pit 4S location. Also, a comparison of the more than 7,000 cubic yards of clean soil used for backfilling with the estimated volume of excavated soil of about 4,000 cubic yards indicates that excavated areas were backfilled up to or above the original grade.

The wastes at Pit S in the West Pits Area were located on top of the native soil and were contained by berms. During backfilling, more than 2-feet of soil was placed over the excavated pit. However, as the original grade for Pit S was above the surrounding topography, the final backfill was also elevated above the surrounding topography. After consultation with, and approval from, EPA, the edges of the backfill of Pit S were regraded to blend in with the surrounding topography for erosion protection.

Following backfilling and grading of the hydrocarbon soil excavations, the graded areas were fertilized and disked. Revegetation of the disked areas was performed by drill seeding in accordance with the mixture and seeding rate specified in the RD. Following drill seeding, straw mulch was applied and crimped at a rate of two tons per acre (see Photo 4-6).

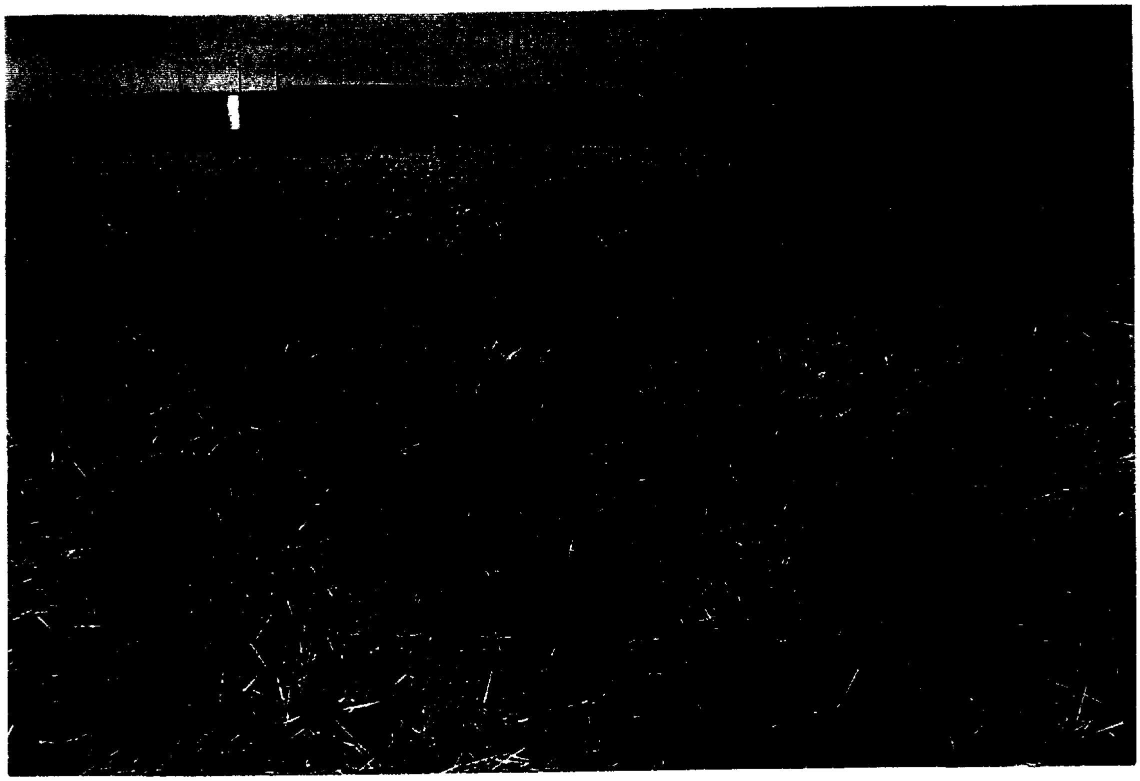

Photo 4-5. Final Backfill of Fence Pit Excavation in West Pits Area

Photo 4-6. Final Backfill and Mulch Application at Pit 4S Excavation

5.0 PREPARATION AND PLACEMENT OF SOILS IN THE LANDFARM

This chapter describes the homogenization of soils for landfarming, the stockpiling of soils, the sampling of soil stockpiles for organic content and nutrients, and the final mixing of soils and placement in the landfarm. The excavation of the hydrocarbon-contaminated soils and West Pit contents was described in Chapter 3.

5.1 Remedial Design Requirements

As stated in Volume 4 of the RD, the scope of work for homogenization and placement of hydrocarbon-contaminated soils in the landfarm includes the following requirements:

- Homogenize soils, including removing sticks, rocks and construction debris, breaking down aggregates and tar balls, and blending soils and wastes in order to produce a relatively uniform soil for treatment in the landfarm.
- Collect composite samples of stockpiled soils for analysis to determine the oil and grease (O&G) loading rate, and the concentrations of nitrogen (N), phosphorus (P), and carbon (C).
- Mix the homogenized soils with background soils, if necessary, to achieve the optimum loading rate for landfarm treatment.
- Mix the homogenized soils with nutrients and a carbon source, if needed, to achieve the optimum C:N:P ratios of 100:5:1.
- Spread homogenized soils in the landfarm cell at a uniform thickness not to exceed 18-inches.

5.2 Homogenization of Hydrocarbon-Contaminated Soils

Soil homogenization was conducted in batches at a soil preparation area. The excavated hydrocarbon soils and the West Pits contents were dozed into a preparation bed to a depth of about 6 to 8 inches. The soils and wastes were homogenized using disc and rotor-tillers as shown in Photo 5-1. Rocks, pipe and construction debris were removed by hand or by dozing during soil homogenization. The soil preparation locations are shown on Figure 5-1. The soil preparation areas were located adjacent to the homogenized soil stockpiles. The soil preparation areas and homogenized soil stockpiles were located near but outside of the West Pits excavations. The dimensions of the homogenized soil stockpiles and preparation areas were restricted to as small an area as was practicable in order to reduce the volume of later surface soil removal required beneath the soil preparation and soil stockpiling locations.

Photo 5-1. Soil Homogenization Using Disc with Homogenized Soil Stockpiles in Background

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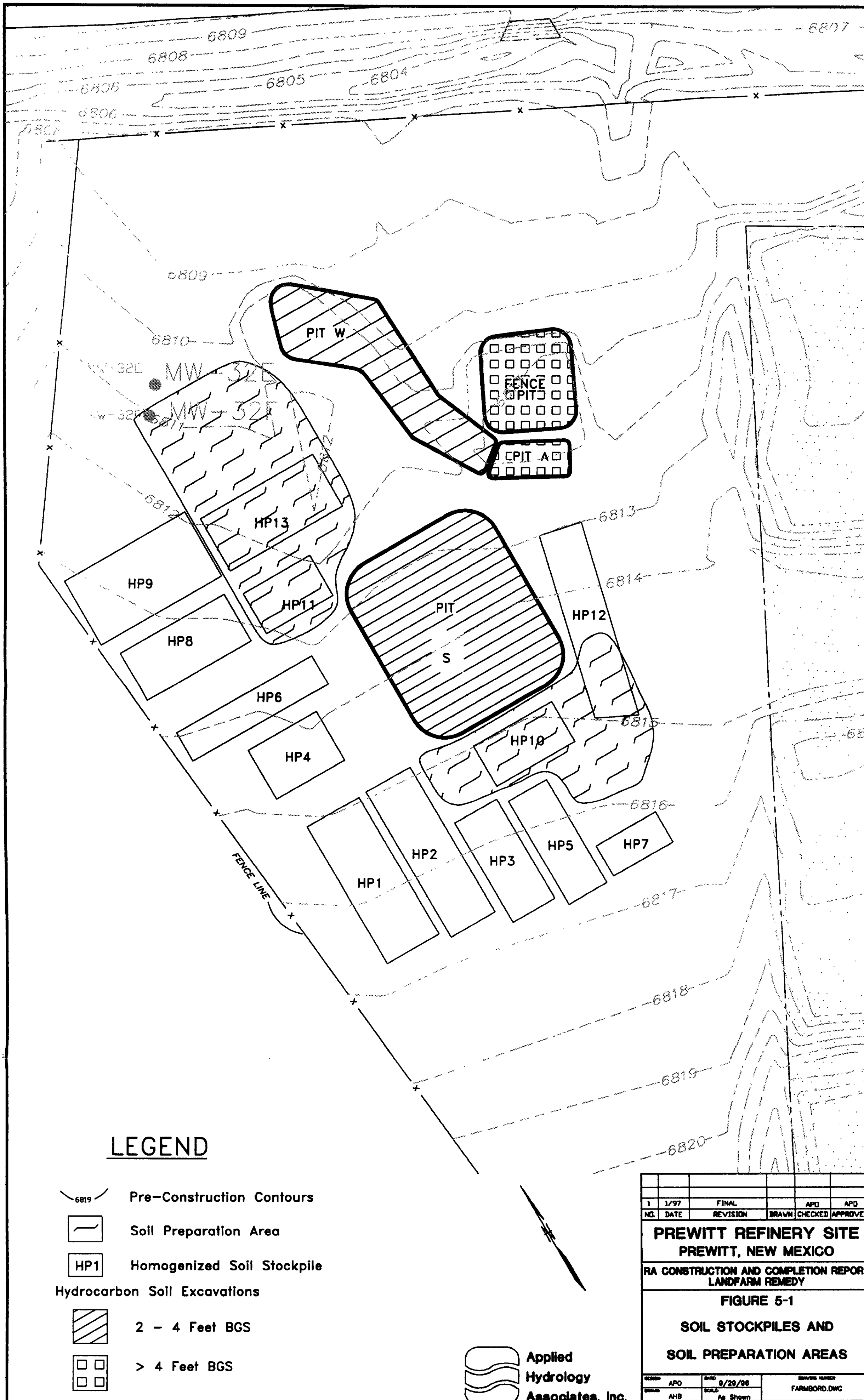

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RA CONSTRUCTION AND COMPLETION REPORT LANDFARM REMEDY

FIGURE 5-1

SOIL STOCKPILES AND SOIL PREPARATION AREAS

DESIGNED: APD	DATE: 9/29/96	DRAWING NUMBER: FARMBORD.DWG	
DRAWN: AHB	SCALE: As Shown		
APPROVED:	PROJECT NO: 52-018	SHEET NO:	

During homogenization, soils from different excavations were mixed in order to obtain more uniform soils for treatment. As excavation and homogenization were proceeding simultaneously, it was generally not possible to mix soils from more than two excavation locations during homogenization. Furthermore, the volume of the contents from the Fence Pit, which included drill cuttings and dry hydrocarbon soils added to facilitate excavation of the oily sludge, was so large that it comprised most of the material in several soil homogenization batches. Despite the operational difficulties in thoroughly mixing soils and wastes from different excavation locations, the sampling results of homogenized hydrocarbon stockpiles in Section 5.3 did not show major differences in hydrocarbon loading and nutrient concentrations among stockpiles. Also, the homogenized soils from all the stockpiles were mixed again during transfer to the landfarm.

5.3 Stockpiling and Sampling of Hydrocarbon-Contaminated Soils

After homogenization, the soils were dozed into homogenized soil stockpiles before starting homogenization of another batch of hydrocarbon soils. Thirteen homogenized soil stockpiles were constructed in the soil preparation area during soil homogenization as shown in Figure 5-1. These homogenized soil stockpiles were measured to determine stockpile dimensions in order to estimate hydrocarbon soil volumes in each stockpile. The results are summarized in Table 5-1.

The total volume of hydrocarbon soil in the thirteen stockpiles is estimated to be 4,287 cubic yards as compared to the estimated excavation volume of approximately 3,100 cubic yards based on dimensions of all the excavations. The difference in the two estimates can be attributed to swell in homogenized soils in the stockpiles, indicating a swell factor of about 38 percent.

Samples were also taken of homogenized soil stockpiles for analysis of nitrogen, phosphorus, carbon, and oil and grease. These samples were collected by the RA Contractor and were analyzed by Hall Environmental Analysis Laboratory of Albuquerque. The analytical results from the first ten stockpiles were determined to be sufficient to proceed with application of soils and addition of nutrients so as not to delay completing the work in order to sample and analyze the last three soil stockpiles.

Table 5-1. Homogenized Soil Stockpile Measurements and Volumes

Homogenized Stockpile	Measurement Location	Length (ft.)	Width (ft.)	Area (sq. ft.)	Avg Height (ft.)	Volume (cu. yds.)
HP1	HP1-top	40	15	600	5.64	240
	HP1-bot	74	23	1702		
HP2	HP2-top	60	13	780	5.39	293
	HP2-bot	80	27	2160		
HP3	HP3-top	53	17	901	6.35	342
	HP3-bot	67	30	2010		
HP4	HP4-top	35	23	805	5.83	252
	HP4-bot	46	33	1518		
HP5	HP5-top	53	14.5	769	6.44	333
	HP5-bot	71	28.5	2024		
HP6	HP6-top	62	15	930	5.32	251
	HP6-bot	81	20	1620		
HP7	HP7-top	47	20	940	6.75	467
	HP7-bot	65	43	2795		
HP8	HP8-top	49	22	1078	5.17	327
	HP8-bot	64	36.5	2336		
HP9	HP9-top	38	19	722	7.22	429
	HP9-bot	65.5	38	2489		
HP10	HP10-top	53	14	742	6.22	308
	HP10-bot	71.5	27	1931		
HP11	HP11-top	30	12	360	5.41	179
	HP11-bot	50	28.5	1425		
HP12	HP12-top	95	9	855	6.20	448
	HP12-bot	115	26.5	3048		
HP13	HP13-top	35	21.5	752.5	6.98	418
	HP13-bot	71	35	2485		
				Total Volume (yd3)		**4,287**

The analytical results are provided in Appendix 5.1 and are summarized in Table 5-2. These results were used to determine whether the O&G loading was less than 5% of the total soil weight as specified in the RD. The sample results were also used to determine the nutrient addition needed to maintain a C:N:P ratio 100:5:1 in the soils applied to the landfarm. As specified in the RD, the O&G content was used as carbon (C) in the nutrient relationship.

Table 5-2. Analytical Results From Homogenized Soil Stockpiles

Stockpile	Stockpile Volume (cu. yds.)	Sample Number	Carbon %	Oil & Grease %	Kheldahl Nitrogen ppm	Phosphorus ppm	Nitrate + Nitrite as N ppm
HP1	240	HC-CS-01	4.4 / 4.7	2.5	686 / 602	9.8 / 9.6	
		HC-CS-02	2.8	2.2	652	10	
		HC-CS-03					7.8 / 7.5
HP2	293	HC-CS-04	4.4 / 4.7	1.8	703	11 / 15	
		HC-CS-05	2.8	3.5	683	14	
		HC-CS-06					6.0 / 5.9
		HC-CS-07					5.7 / 5.6
HP3	342	HC-CS-08	3.3	3.1	650	8.1	
		HC-CS-09	3.7	3.4	630	8.3	
		HC-CS-10					4.7 / 4.8
		HC-CS-11					6.4 / 6.5
HP4	251	HC-CS-12	3.6	3.2	740	11	
		HC-CS-13	2.8	3.1	900 / 660	11 / 8	
		HC-CS-14					6.7
		HC-CS-15					3.9 / 4.1
HP5	333	HC-CS-16	3.5	2.7	510 / 610	9.2 / 9.0	
		HC-CS-17	2.8	3	480	9.6	
		HC-CS-18					<1
		HC-CS-19					3.9 / 4.1
HP6	251	HC-CS-20	3.3	2.8	600	9.9	
		HC-CS-21	3.4	2.5	600	9.4	
		HC-CS-22					<1
		HC-CS-23					<1
HP7	467	HC-CS-24	3.3 / 3.1	2	580 / 580	7.6 / 6.7	
		HC-CS-25	3.4	2.3	650	9.1	
		HC-CS-26					<1
		HC-CS-27					<1
HP8	327	HC-CS-28	3.2	2.3	600	6.9	
		HC-CS-29	3.1	2.4	540	7.4	
		HC-CS-30					<1
		HC-CS-31					3.1 / 3.0
HP9	429	HC-CS-32	3.3	2.4	460	8.2	
		HC-CS-33	3.7	2.5	520	7.4	
HP10	308	HC-CS-34	2.8	1.4	820	5.4	
		HC-CS-35	3.1	2.1	690	5.9	
Weighted Average			3.257	2.54	620	8.7	3.7

The O&G content in the homogenized soils in stockpiles varied from 1.4 to 3.5 percent with a volume weighted average of 2.54 percent, which is below the maximum O&G loading of 5 percent specified in the RD. Thus, no mixing of background soil with the homogenized soil was necessary to achieve optimum organic loadings.

Given the O&G loading of 2.54 percent, the corresponding nitrogen and phosphorus needed for optimal biotreatment in the landfarm was 1,270 and 250 ppm, respectively. Since the average concentrations of nitrogen and phosphorus in the homogenized soil stockpiles were 624 and 9 ppm, respectively, nutrients were added to obtain a C:N:P ratio of 100:5:1 as specified in the RD.

5.4 Final Mixing of Hydrocarbon-Contaminated Soils and Placement in the Landfarm

Soils from all the homogenized soil stockpiles were dozed and mixed to create one stockpile in order to obtain a more uniform blend for landfarm treatment. The homogenized soils were then placed in the landfarm, above the buffer layer, in two six-inch lifts. After placement of each lift, nutrients in solid form were added by using a broadcaster and mixed into the soils with a rotor-tiller. A total of 14,250 lbs. of 46 percent nitrogen, and 5,350 lbs. of 46 percent phosphorus were added to achieve the 100:5:1 ratios for hydrocarbon:nitrogen:phosporus.

Consistent with the EPA agreement, two to three inches of soils were excavated from areas where hydrocarbon soils were homogenized and stockpiled to assure that no residual contamination was left behind. The excavated soil, approximately 350 cubic yards, was included in the soils applied to the landfarm for treatment. The total volume of soils applied to the landfarm is estimated to be about 4500 cubic yards. A final survey was performed to determine elevation of the top of the treatment zone in the landfarm. The final survey results are provided in Appendix 3.1. The plan drawing of the constructed landfarm provided in Figure 3-2 was based on the final survey.

6.0 INSPECTION OF THE LANDFARM REMEDY

Chapter 6 describes the inspection of the landfarm, including the Pre-Final Inspection.

6.1 Construction Inspections

EPA oversight personnel were present full time during the entire construction and inspected all phases of construction. Representatives of ARCO/EPNG, including the Site Manager from AVM Environmental Services, were also present during construction to ensure that the work was performed in accordance with the approved designs and specifications and with the contract. The SC/QAO inspected the excavation of hydrocarbon soils, the homogenization and stockpiling of hydrocarbon soils, and the construction of the landfarm liner. The SC/QAO was also present for confirmatory sampling and was responsible for determining that hydrocarbon-contaminated soils were excavated in accordance with the RD.

The hydrocarbon-contaminated soil excavations were visually inspected to insure that the horizontal limits of excavation included all visual hydrocarbon-contaminated soil. Locations of West Pit berms and evidence of hydrocarbon staining were used to determine the limits of excavation. Pre-excavation sampling and/or confirmatory sampling results were used to define the depth of excavation and to ensure attainment of performance standards.

Inspections of the landfarm were conducted throughout all stages of construction. Inspections verified adequate removal of vegetation, debris and rocks prior to construction of the clay liner. Liner construction was inspected. Elevation surveys and field density tests were performed as described in Chapter 3 to verify placement of at least 6 inches of minimum 95 percent MDD compacted clay. Construction of the buffer-soil layer was inspected and surveyed to insure placement of at least four inches of buffer soil above the clay liner.

Inspections of the hydrocarbon-soil homogenization were performed to insure that the dozing and tilling work provided adequate mixing. During inspections, health and safety procedures were examined and deficiencies were brought to the immediate attention of the RA Contractor's Site Manager.

The EPA, New Mexico Environment Department (NMED), Navajo Superfund Program (NSP), and US Army Corp. of Engineers (COE) visited the Site on June 19, 1996 and observed the landfarm remedy construction work in progress. Construction progress and the schedule were discussed with the EPA.

6.2 Pre-Final Inspection

After completion of landfarm construction, a Pre-Final Inspection was conducted by EPA on July 10, 1996 with the ARCO/EPNG on-site representative (AVM Environmental Services), the EPA RPM, and the EPA oversight from the US Army Corps of Engineers present. The purpose of the Pre-Final Inspection of the Landfarm Remedy was to determine if all aspects of the plans and specifications were implemented for removal of hydrocarbon soils, for construction of the landfarm, and for homogenization and placement of hydrocarbon soils in the landfarm for treatment. Items covered at the Pre-Final Conference included:

- Inspection of all soil excavation areas and of the constructed landfarm.
- The proposed plan to re-contour the backfill of the S Pit to fit surrounding topography.
- Confirmatory sampling of excavations and results.
- Operation and Maintenance procedures and the frequency of tilling
- Inspection of sprinkler operation.

Following the Pre-Final Inspection, a conference call was conducted on July 11, 1996 to discuss the results of the Pre-Final Inspection with NMED, NSP, and the ARCO and EPNG Project Managers. EPA indicated that there were no outstanding items related to landfarm construction and that ARCO/EPNG should proceed with the preparation of the Draft Construction Report for the Landfarm Remedy which would be due within 90 days of July 11, 1996.

6.3 Construction Completion and Acceptance of the Landfarm Remedy

Since there were no outstanding issues or items identified during the Pre-Final Inspection and the landfarm sprinklers were operating, the Landfarm Remedy was deemed to be operational and landfarm operation and maintenance activities were started the week of July 15, 1996. The first six chapters of this RA Construction and Completion Report were prepared and submitted in accordance with Section 4.3 of the RA Work Plan

7.0 LANDFARM OPERATION AND MAINTENANCE

This section describes Operation and Maintenance (O&M) activities which were conducted in accordance with the RD Report, Volume 4.0, Section 4.0, for Long Term Remedial Action (LTRA) of the Landfarm Remedy. After the landfarm construction and application of hydrocarbon soil for treatment, the pre-final inspection for the Landfarm Remedy construction was conducted by the EPA on July 10, 1996. As indicated in the EPA's September 23, 1996 notification, the Landfarm Remedy was determined by the EPA to be operational and functional. The RD requires O&M for the Landfarm Remedy LTRA until the 4.5 ppm benzo(a)pyrene equivalents Landfarm Treatment Standards (LTSs) for CPCs, as presented in Table 7-1, have been attained.

Table 7-1

Landfarm Treatment Standards

PAHs (CPCs)	Landfarm Treatment Standards, 4.5 ppm benzo(a)pyrene equivalent (1)
Benzo(a)anthracene	45.0 ppm
Benzo(b)fluoranthene	45.0 ppm
Benzo(k)fluoranthene	45.0 ppm
Chrysene	450.0 ppm
Benzo(a)pyrene	4.5 ppm

(1) Carcinogenic risks of PAHs are additive. Therefore, when more than one PAHs are found, the 4.5 ppm standard applies to the benzo(a)pyrene equivalents total of detected PAHs.

The landfarm soil baseline (pre-treatment) sampling results indicated that the LTSs were initially attained, therefore, further O&M activities were not necessary. Nevertheless, O&M was implemented and maintained until the performance monitoring confirmed attainment of the LTSs. The landfarm O&M activities started in July 1996, and terminated in October 1996.

7.1 O&M Remedial Design Requirements

In accordance with the RD, Volume 4, the O&M Scope of Work for the Landfarm Remedy consists of the following requirements:

- Estimate CPCs (PAHs) mass removal rates and the change in these rates over time
- Maintain optimum soil moisture rate, C:N:P ratio, and tilling frequency to maximize biodegradation of the CPCs
- Determine when system modifications are required to enhance contaminant mass removal rates
- Determine when performance standards have been attained.

7.2 Baseline Determination of PAHs Content in the Landfarm Soil

Four landfarm soil composite samples were collected on July 5, 1996 to establish the baseline PAHs content and contaminant mass prior to the O&M activities. The samples were collected in accordance with performance monitoring sampling described in the Addendum to the Remedial Action Sampling and Analysis Plan (RA SAP) for the Landfarm Remedy (RD Report, Volume 4 Landfarm Remedy, Section 7.0). However, after discussion with EPA's on-site representative, the composite sample point density was increased from a four-point, as specified in RD, to a five-point composite as shown in Figure 7-1 to include the middle area of each landfarm section for a more representative sampling.

The samples were collected using a hand auger. Figure 7-1 shows the July 5, 1996 sampling locations. Photos 7-1 to 7-6 show sample collection and preparation activities. The samples were sent to ACZ Laboratories in Steamboat Springs, Colorado, for PAHs analysis. Analytical results are provided in Appendix 7.1 The PAHs concentrations, as well as the benzo(a)pyrene equivalent

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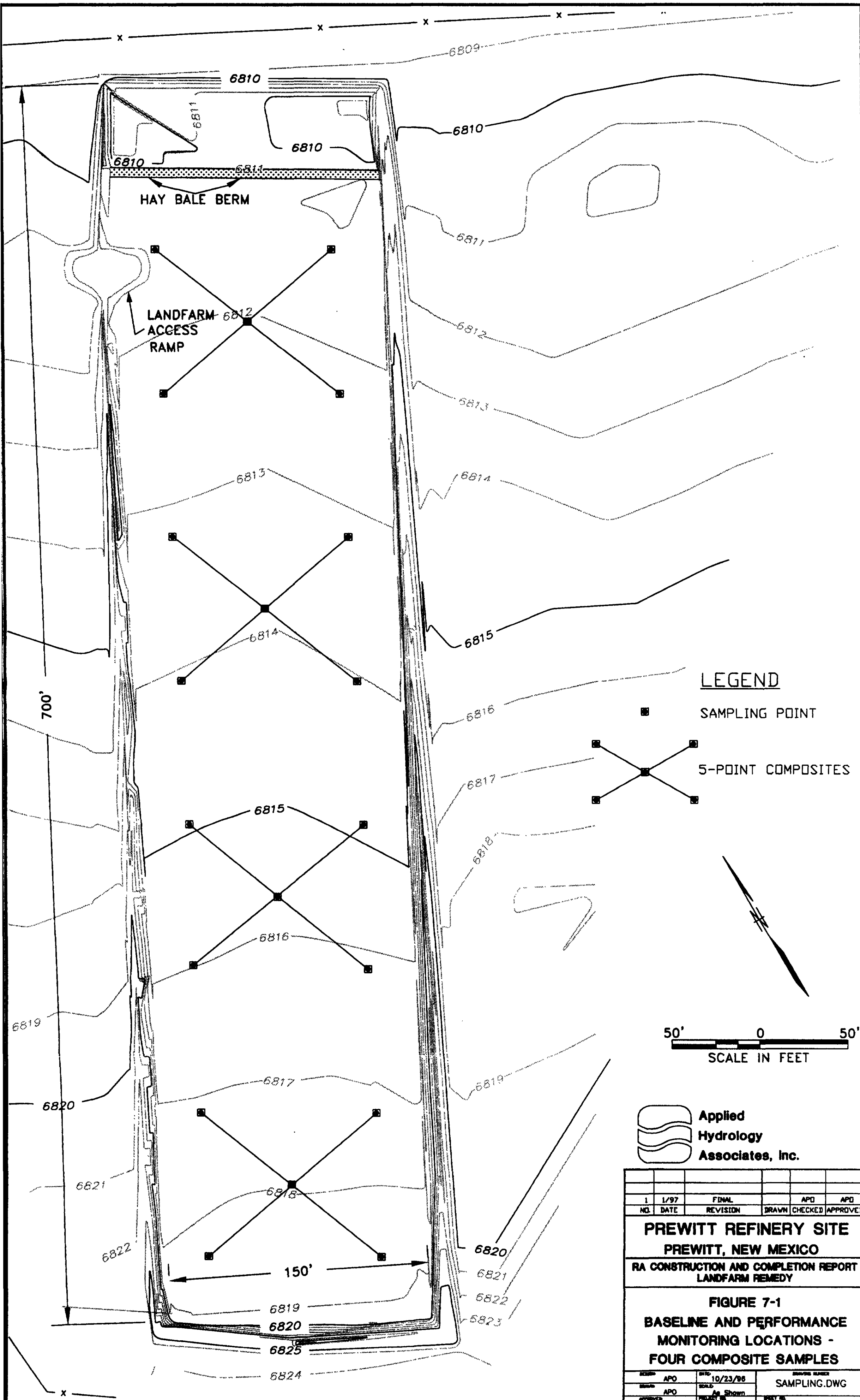
Title Prewitt Refinery Site - RA Construction and Completion Report - Landfarm Remedy - Figure 7.1 Baseline and performance Monitoring Locations - Four Composit Samples



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RA CONSTRUCTION AND COMPLETION REPORT
LANDFARM REMEDY

FIGURE 7-1
BASELINE AND PERFORMANCE MONITORING LOCATIONS - FOUR COMPOSITE SAMPLES

APO	10/23/96	SAMPLING.DWG
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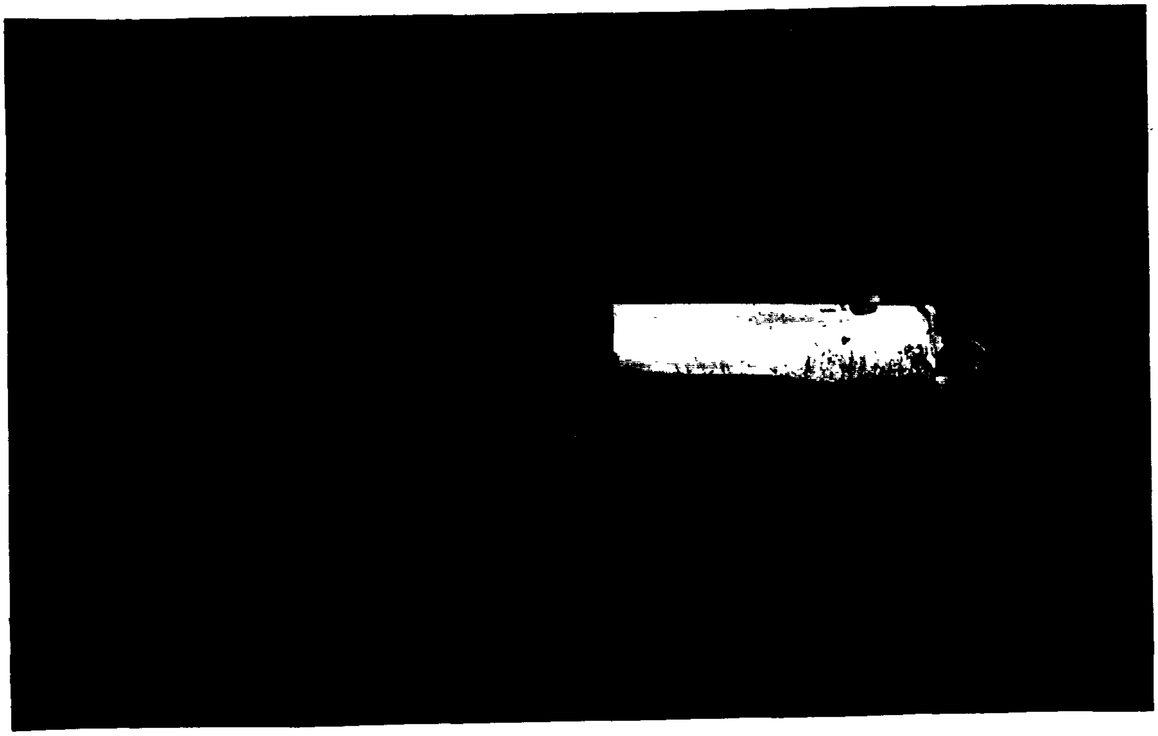

Photo 7-1. Hand Auger for Soil Sample Collection

Photo 7-2. Driving Hand Auger into the Landfarm Soil for Sample Collection

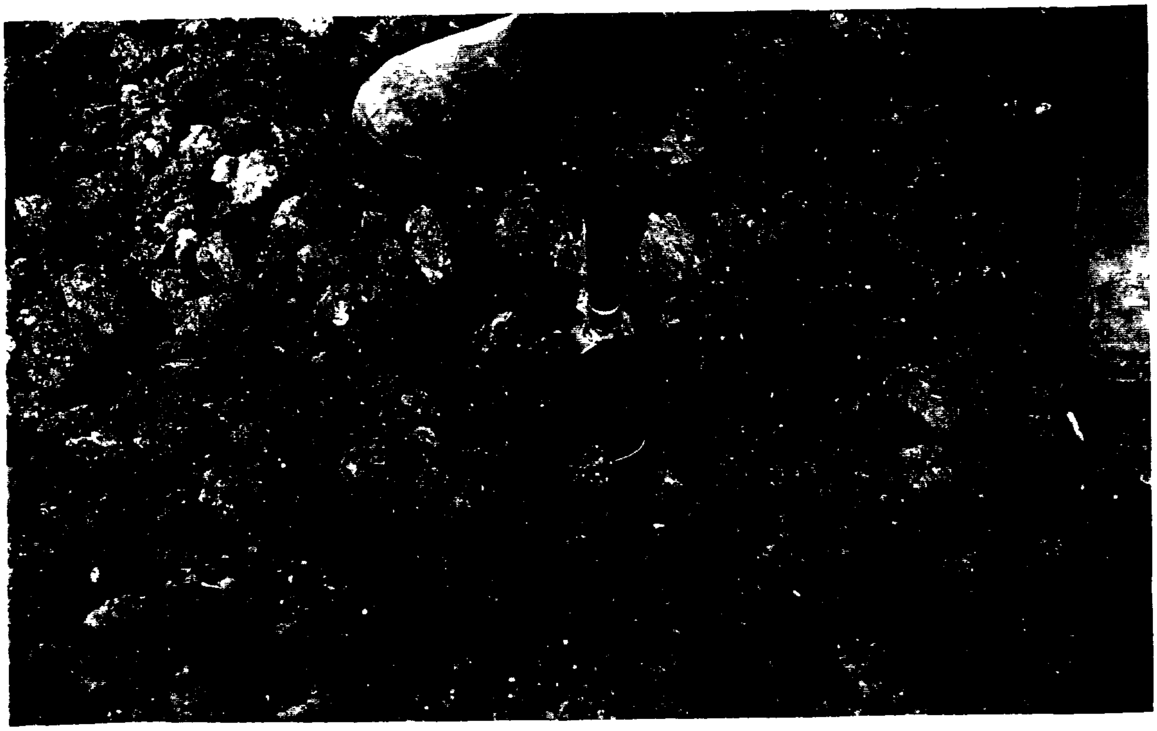

Photo 7-3. Sample Auger to the Sampling Depth

Photo 7-4. Composite Sample Aliquot

Photo 7-5. Soil Sampling Grinding During Sample Preparation

Photo 7-6. Soil Sample Screening Through 10 Mesh Sieve During Sample Preparation

calculations are summarized in Table 7-2. These results show that the individual PAH concentrations are below the LTSs, and that the total of benzo(a)pyrene equivalents range from 3.4 to 4.7 ppm with an average of 4.1 ppm, below the 4.5 benzo(a)pyrene LTS.

Table 7-2
Results of the Baseline Sampling Conducted on July 5, 1996

	PM-CS-1			PM-CS-2			PM-CS-3			PM-CS-4			PM-CS-5(1)		
PAHs	Conc. ppm	Q	Benzo (a) pyrene,eq ppm	Conc. ppm	Q	Benzo (a) pyrene,eq ppm	Conc. ppm	Q	Benzo (a) pyrene,eq ppm	Conc. ppm	Q	Benzo (a) pyrene,eq ppm	Conc. ppm	Q	Benzo (a) pyrene,eq ppm
Benzo(a)anthracene	4.900		0.490	4.300		0.430	2.900	J	0.290	3.300		0.330	2.600	J	0.260
Benzo(b)fluoranthene	3.300	U	0.330	3.300	U	0.330	3.300	U	0.330	3.300	U	0.330	3.300	U	0.330
Benzo(k)fluoranthene	3.300	U	0.330	3.300	U	0.330	3.300	U	0.330	3.300	U	0.330	3.300	U	0.330
Chrysene	5.000		0.050	4.800		0.048	3.600		0.036	4.700		0.047	3.600		0.036
Benzo(a)pyrene	3.500		3.500	3.600		3.600	2.400	J	2.400	2.400	J	2.400	2.400	J	2.400
TOTAL			**4.700**			**4.738**			**3.386**			**3.437**			**3.356**

(1) PM-CS-5 is a QA/QC Duplicate sample of PM-CS-3
"U" Indicates compound was not detected
"J" Indicates compound detected < MDL
"B" Indicates compound was found in daily calibration blank

The baseline mass of individual PAHs and the benzo(a)pyrene equivalents are summarized in Table 7-3. A final landfarm soil volume of 3850 cy was estimated based on the final elevation of the top of the treatment zone and buffer soil layer. A total landfarm soil weight of 8,470,000 lbs was determined using a soil density of 2200 lbs/cy. For PAHs mass calculations, half the value of the Method Detection Limit (MDL) was used when a PAH was not detected. A total landfarm baseline mass of 124.1 lbs PAHs, and 31.6 lbs of total benzo(a)pyrene equivalents was determined.

Table 7-3
Baseline Mass of PAHs

	Baseline (July 1996) PAH Mass, lbs			
PAH	Avg. Conc. ppm(1)		PAH Mass lbs	Benzo (a)pyrene Equiv. mass, lbs
Benzo(a)anthracene	3.850		32.610	3.261
Benzo(b)fluoranthene	1.650	(2)	13.976	1.398
Benzo(k)fluoranthene	1.650	(2)	13.976	1.398
Chrysene	4.525		38.327	0.383
Benzo(a)pyrene	2.975		25.198	25.198
TOTAL			**124.086**	**31.638**

(1) July 1996 baseline sample results average.
(2) Half the MDL value was used since the compound was not detected.

7.3 Monitoring and Maintenance of Moisture Content

The RD required landfarm soil irrigation to maintain moisture content at the optimum range of 13 to 20 percent for efficient biodegradation of landfarm soil. However, based on the July 1996 baseline sampling discussed in Section 7.2, the LTSs had already been attained. Nevertheless, the landfarm soil irrigation was implemented on July 22, 1996. Landfarm irrigation was conducted as needed. Photos 7-7 and 7-8 show the landfarm irrigation sprinkler system in operation. A total of 37,400; 231,600; 148,600; and 137,300 gallons of water was applied to the landfarm soils during the month of July, August, September, and October 1996, respectively. Landfarm irrigation activities were recorded in the Landfarm Operation and Maintenance logs, which are included in Appendix 7.2.

The RD specified landfarm soil moisture content determination on a weekly basis during the potential maximum degradation months of May through September, and on a monthly basis for the remainder of the year. Moisture sampling was conducted in accordance with the RA SAP, although the sampling locations were modified. The RA SAP specified that a grab soil moisture sample be collected from the center of each 0.25 acre section of the landfarm. This would have resulted in eight samples. Instead, a five-point composite sample, rather than one grab sample was collected from each 0.3 acre section throughout the landfarm. This resulted in eight composite samples. The sampling locations are shown in Figure 7-2. Sampling point density was increased by performing composite sampling to obtain more representative moisture content for each section. A hand auger was used to collect composite moisture sample aliquots. A composite sample for each section of the landfarm was prepared by combining all equal weight aliquots from that section, and then homogenizing. Approximately 1000 grams of sample was weighed, then dried in an oven at 105° C for 18 to 24 hours, and weighed again to determine moisture content. Photos 7-9 to 7-10 shows weighing and drying for moisture sampling.

During August 1996, eight five-point composite soil moisture samples were taken on a weekly basis. The results, included in Appendix 7.3, show average weekly moisture contents at 8%, 10.7%, 12.5% and 21.7%. The average moisture content for the first three weeks were slightly

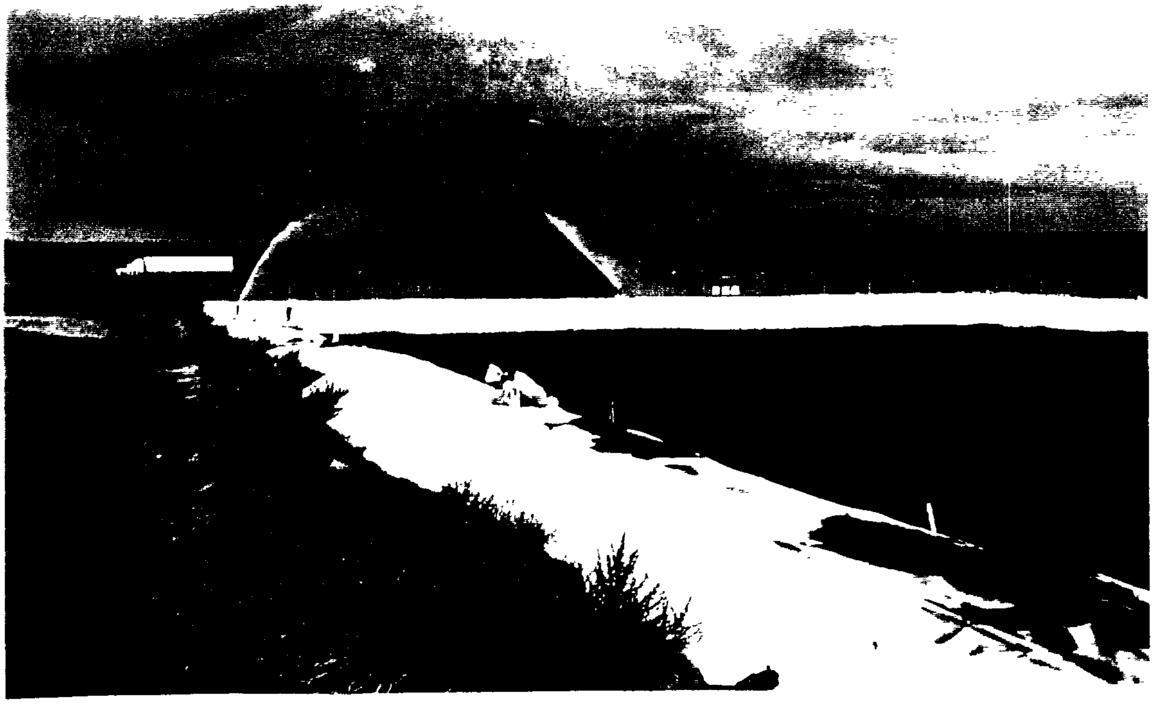

Photo 7-7. Landfarm Irrigation Sprinkler System

Photo 7-8. Landfarm Irrigation Sprinkler System

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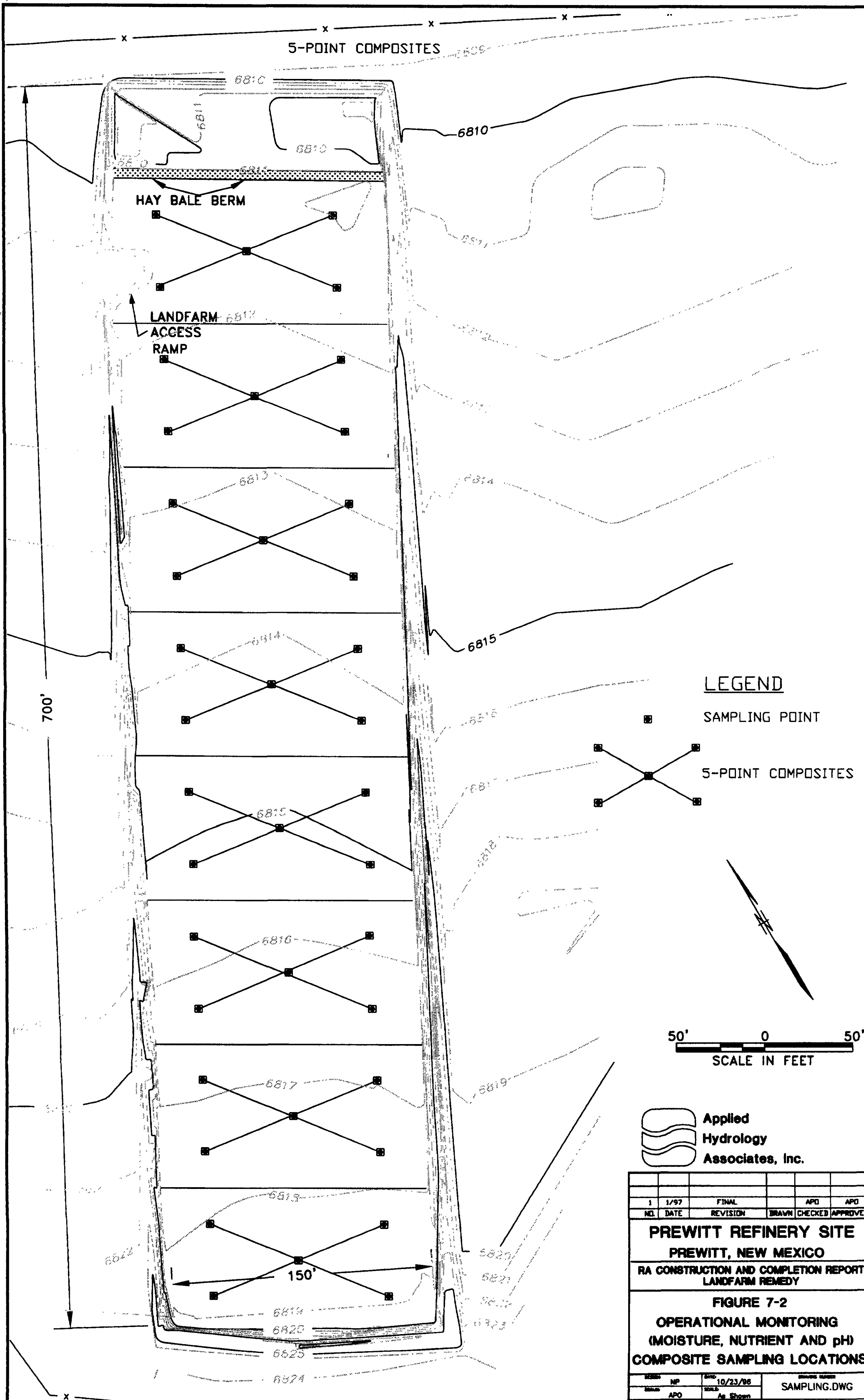

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PREWITT REFINERY SITE
PREWITT, NEW MEXICO
RA CONSTRUCTION AND COMPLETION REPORT
LANDFARM REMEDY

FIGURE 7-2
OPERATIONAL MONITORING (MOISTURE, NUTRIENT AND pH) COMPOSITE SAMPLING LOCATIONS

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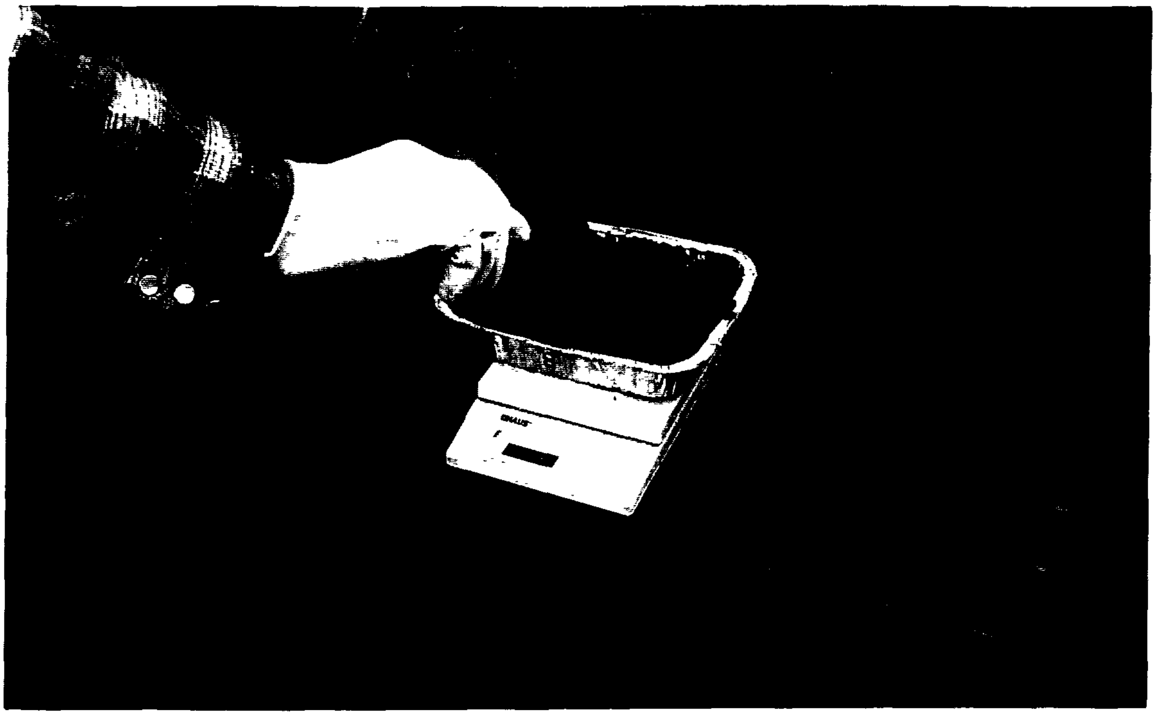

Photo 7-9. Landfarm Moisture Sample Weighing

Photo 7-10. Landfarm Moisture Sample Drying

below the optimum range of greater than 13%. One of the reasons for low moisture was that both the Shop Well pump and the booster pump could not be operated simultaneously to provide sufficient water to maintain the optimum moisture. A larger electric transformer was installed in an attempt to operate both pumps. However, it was still not possible to operate both pumps simultaneously. The other reason for low soil moisture was that the sprinklers on the berms did not cover all landfarm areas. Four additional portable lines and sprinklers, which are shown in Photo 7-11, were installed to irrigate areas not covered by the berm sprinkler system. Although, measures were taken in an effort to increase moisture content, maintenance of optimum moisture was not crucial since the LTSs have been attained within the landfarm as indicated by the baseline sampling.

Weekly moisture sampling of the landfarm soils continued during the month of September and October 1996. The sampling results, summarized in Appendix 7.3, show moisture content for September ranged from 19.4% to 41.8%, with an overall average for the month at approximately 26%, which is slightly above the optimum range of 13% to 20%. The October moisture content ranged from 18.9% to 22.4%, with an average of 20.4%.

Photo 7-11. Landfarm Portable Sprinklers

Above normal rain during these months resulted in the landfarm moisture slightly above the optimum range.

Since the LTSs were attained, as confirmed by the performance sampling discussed in Section 7.7, O&M activities for monitoring and maintenance of moisture content were terminated in October 1996.

7.4 Tilling of Landfarm Soils for Optimum Aeration

Prior to the O&M tilling activities, the landfarm soil was ripped during the week of July 15th, because the placed soil had become slightly compacted due to heavy equipment traffic during the soils placement and nutrient addition. The RD required tilling of the landfarm soil once per week for the months from May to September, and on a monthly basis October through April.

The landfarm soil tilling was started during the week of July 22, 1996. A nine inch rotor-tiller, as shown in Photos 7-12 and 7-13, was used to till the landfarm soil. Whenever practical, tilling was conducted at a frequency of at least once per week, as specified in the RD, and more frequent when moisture conditions permitted. The tilling frequency was increased to promote maximum degradation during the warm weather. Because the tilling mixes and aerates soil to a depth of about six to eight inches, and the landfarm soil contains some fine particle clay soil which promotes compaction, landfarm soil was again ripped and turned over using a plow on August 21, 1996, to expose and aerate the bottom part of the one foot landfarm soil layer.

The O&M tilling activities are recorded in the Landfarm Operation and Maintenance log, provided in Appendix 7.2. Since the landfarm treatment standards have been attained, as confirmed by the performance sampling discussed in Section 7.7, the O&M landfarm soil tilling activities were terminated in October 1996.

Photo 7-12. Landfarm Soil Rotor Tilling

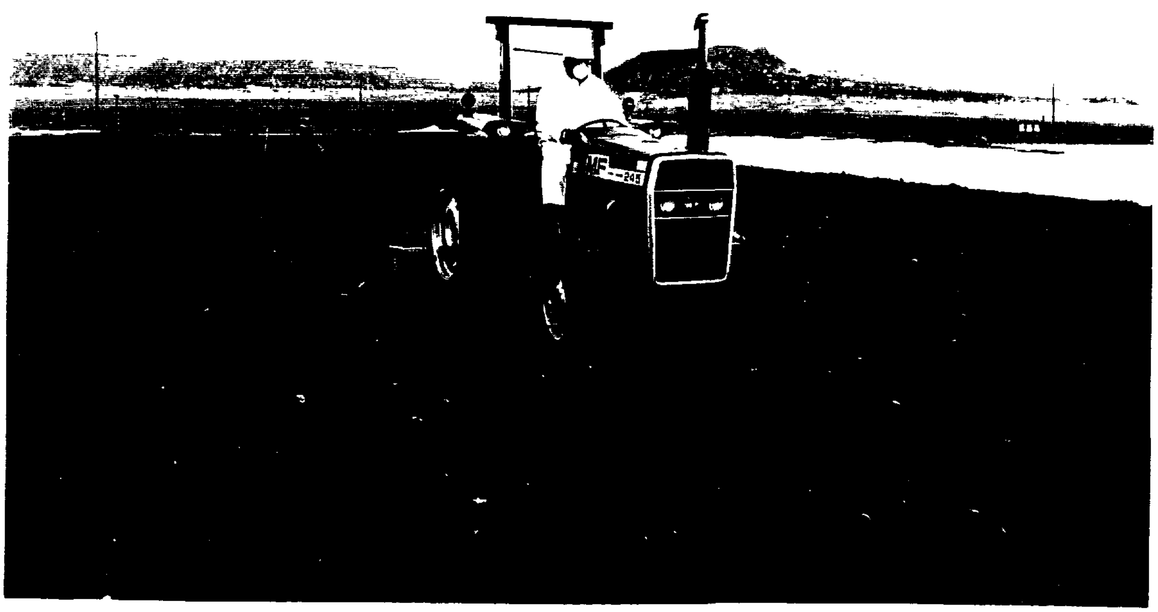

Photo 7-13. Landfarm Soil Rotor Tilling

7.5 Monitoring and Maintenance of Nutrient Levels

The RD required that the nutrient levels in the landfarm soil be maintained at the optimum C:N:P ratio of 100:5:1. Landfarm soil sampling to monitor nutrient levels was specified on a monthly frequency. The RD required a nutrient grab sample from the center of each 0.25 acre throughout the landfarm. Nutrient sampling was conducted in accordance with the RA SAP, except the composite sampling point locations. Similar to the landfarm soil moisture sampling, a five-point composite sample of the treatment zone thickness was collected, rather than a grab sample, from each 0.3 acre throughout the landfarm. This sampling point density was increased to obtain a more representative sample from each landfarm section. Nutrient sampling locations are shown in Figure 7-2. For increased analytical accuracy, nutrient samples were sent to Energy Laboratories Inc., in Casper, Wyoming, for analysis rather than conducting on site analysis using soil test kits.

Since the nutrients were applied to the landfarm soil in July 1996 to initiate the landfarm operation at the appropriate C:N:P ratio of 100:5:1, nutrient monitoring was not conducted during July 1996. Eight composite samples were taken in August 1996 to determine nutrient levels. In addition to the nitrogen and phosphorus, the samples were also analyzed for petroleum hydrocarbon to determine the C:N:P ratio. The sampling results are summarized in Table 7-4. The petroleum hydrocarbon level was measured at 2.1%. The measured total nitrogen content was 0.16%, which is slightly above the 0.1% needed for a 20:1 ratio of hydrocarbon to nitrogen. However, the total phosphorus concentration of 0.007% was below the 0.014% level needed to maintain a 100:1 ration of C:P. Therefor, 2500 lbs of 46% phosphate nutrient was applied to the landfarm soil in September 1996 to increase phosphate level to the 100:1 C:P ratio. The nutrient was applied to the landfarm using a broadcaster, as shown in Photo 7-14, and mixed into soil with a rotor-tiller.

Eight nutrient composite samples were also collected in September 1996. Samples were analyzed for nitrogen, phosphorus, and petroleum hydrocarbon for maintenance of appropriate C:N:P ratio. The sampling results included in Appendix 7.4 are summarized in Table 7-5. The average nitrogen content was 0.18% in September 1996, similar to the August 1996 sampling results.

Table 7-4

August 1996 Nutrient Sampling Results

Sample Description	Sample Date	Petroleum Carbon, ppm	Kjeldahl Nitrogen, ppm	Phosphorus ppm	Nitrate/Nitrite ppm
N-CS-1	8/14/96	18,900	1,560	54.0	2.8
N-CS-2	8/14/96	20,600	1,750	89.6	3.6
N-CS-3	8/14/96	22,000	1,500	51.9	1.0
N-CS-4	8/14/96	22,700	1,690	50.6	0.5
N-CS-5	8/14/96	21,900	1,750	77.1	2.3
N-CS-6	8/14/96	24,600	1,340	58.3	1.0
N-CS-7	8/14/96	23,800	1,400	111.0	1.1
N-CS-8	8/14/96	16,600	1,810	88.0	5.8
AVERAGE		21,043	1,600	72.6	2.3
AVERAGE %		2.104	0.160	0.007	0.000

	% Nitrogen	% Phosphorus
Required for a 100:5:1 C:N:P ratio @ 2.10% C	0.105	0.021
Adjustment for a 100:5:1 C:N:P ratio @ 2.10% C	0.000	0.014
Lbs of Nutrient needed @ 46% content	**0**	**2500**

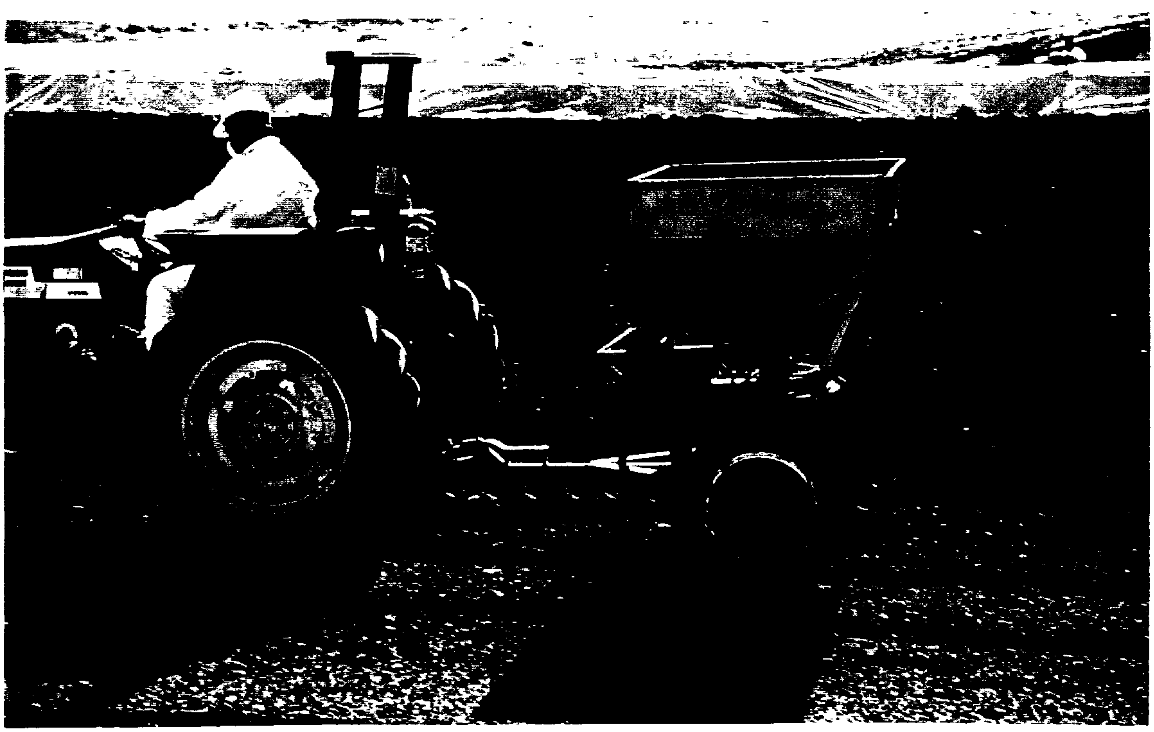

Photo 7-14. Nutrient Application to the Landfarm Soil

Table 7-5

September 1996 Nutrient Sampling Results

Sample Description	Sample Date	Petroleum Carbon, ppm	Kjeldahl Nitrogen, ppm	Phosphorus ppm	Nitrate/Nitrite ppm
N-CS-1	9/25/96	1,530	1,810	104	42.8
N-CS-2	9/25/96	2,090	1,810	74.8	45.5
N-CS-3	9/25/96	2,060	1,810	110	42.8
N-CS-4	9/25/96	2,320	1,690	321	38.9
N-CS-5	9/25/96	1,360	1,810	361	29.6
N-CS-6	9/25/96	661	1,620	578	29.2
N-CS-7	9/25/96	3,150	1,810	427	10.6
N-CS-8	9/25/96	2,710	2,060	275	7.8
AVERAGE		1,985	1,803	281.4	2.3
AVERAGE %		0.199	0.180	0.028	0.000

The phosphorus level was measured at 0.028%, an increase from the 0.007% measured by August sampling results because phosphate nutrient was added to the landfarm soil to adjust the C:P ratio. However, the average hydrocarbon content was reported at 0.2%, which was significantly lower compared to the 2.1% measured in August 1996. The hydrocarbon level appears to be erroneous, probably due to sampling or analytical error, because the very high hydrocarbon degradation from 2.1% to 0.2% is unlikely during one month. The laboratory was contacted for investigation of sample results. The re-analysis result of a few selected samples were fairly similar to the original results. On October 21, 1996, a 40-point composite special sample of the landfarm soil was collected in an attempt to determine proper hydrocarbon level. The results indicated the hydrocarbon level at 1.05%, a more likely level than the 0.2% reported by the September sampling results. Based on the 1.05% hydrocarbon level, and the nitrogen and phosphorus levels determined by the September 1996 sampling, no additional nutrient was required as the landfarm soil C:N:P ratio was 100:17:3, above the required operational ratio of 100:5:1. Although, measures were taken in an effort to determine and maintain nutrient level, maintenance of optimum nutrient levels were not crucial since the LTSs have been attained within the landfarm as indicated by the baseline and performance monitoring.

7.6 Monitoring and Maintaining Landfarm Soil pH

The RD specified that the landfarm soil pH be monitored at a frequency of once per month. However, the RD did not specify maintenance of pH at any specific level or range. Because the sampling locations were similar to the soil moisture locations, pH was monitored at a higher frequency using a portion of the samples collected for moisture analysis. As specified in the RD, pH of the soil was determined by measuring the pH of a slurry of equal ratio of landfarm soil and deionized-distilled water (100 gm soil to 100 ml of water) using a pH meter, as shown in Photos 7-15 and 7-16. The results, included in Appendix 7.3, show that the landfarm soil pH generally ranged between 7.5 to 8.5, typical of clay soils, without any peculiar trend or significant deviations.

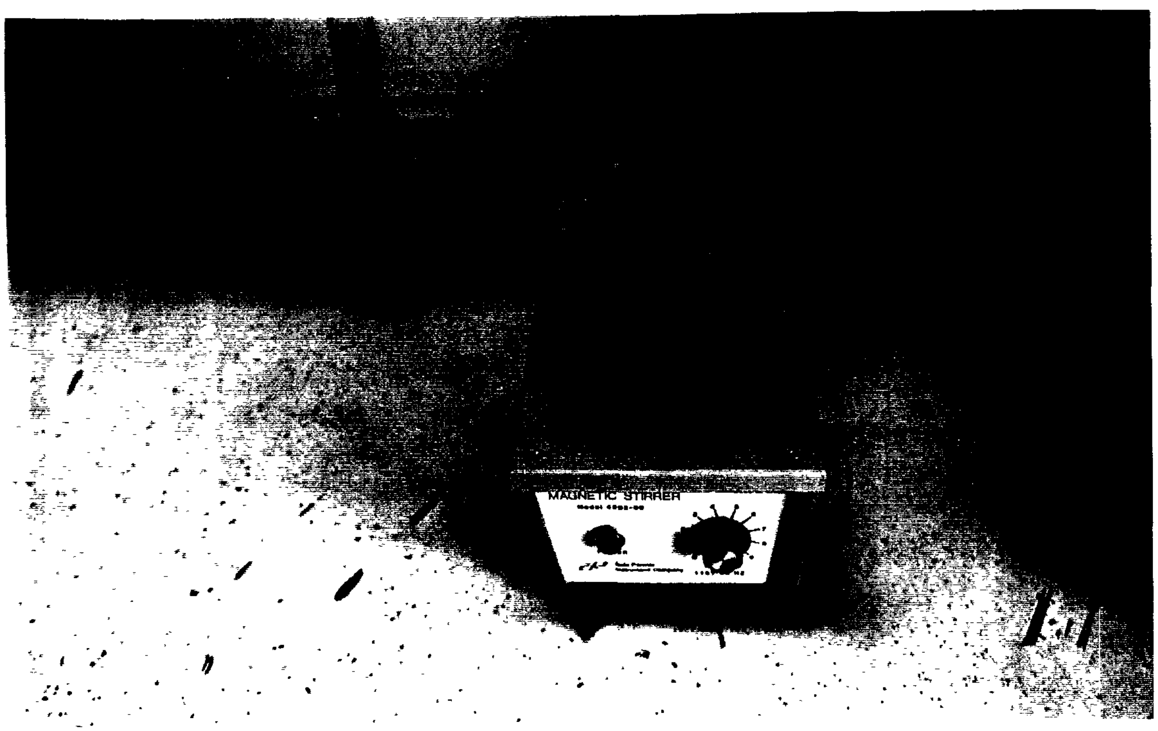

Photo 7-15. Preparation of Landfarm Soil Slurry for pH Measurement

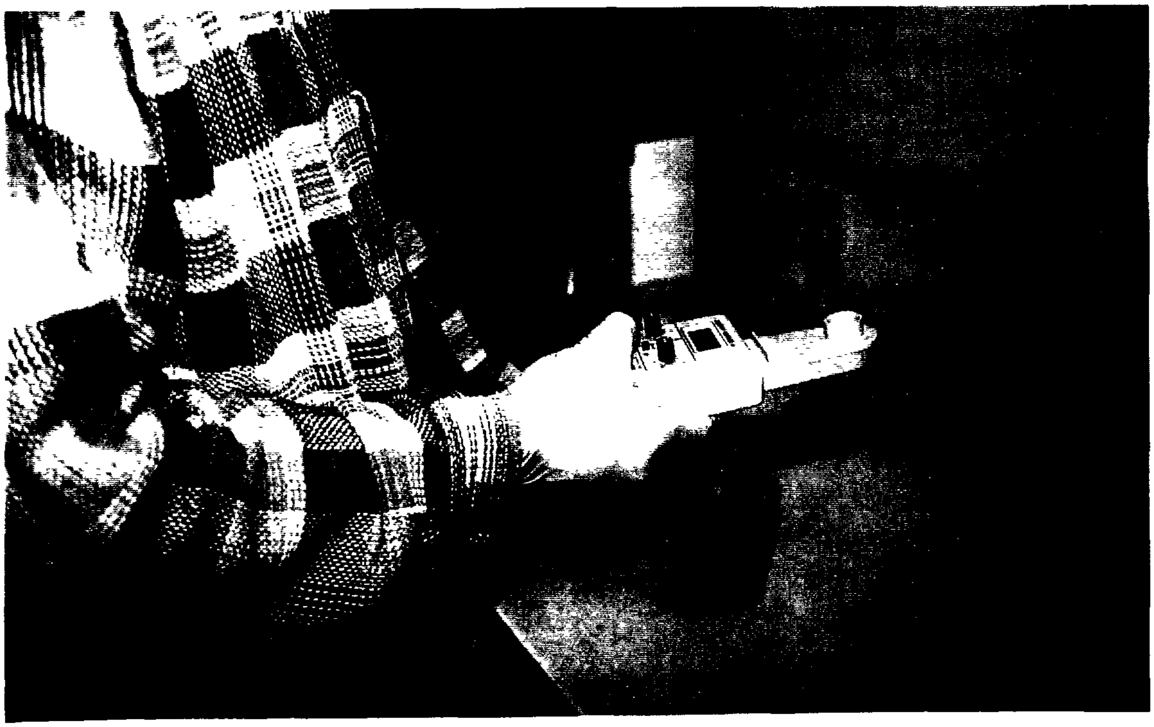

Photo 7-16. pH Measurement of Landfarm Soil Slurry

7.7 Performance Monitoring and Estimation of Contaminant Mass Removal Rates

The RD specified that the performance monitoring samples be collected twice during the first year of the landfarm O&M. First round of sampling was specified in early spring to evaluate the status of the treatment process prior to the summer months, when the greatest degradation of contaminants should occur. The second sampling event was scheduled in late fall (October) to evaluate the status of the treatment process at the end of the optimum treatment season.

The baseline sampling results indicating attainment of the LTSs were discussed during the August 2, 1996 telephone conference meeting between the EPA, New Mexico Environment Department (NMED), U. S. Army Corp. of Engineers (COE), and ARCO/EPNG. The EPA requested that additional two rounds of sampling be conducted to confirm that treatment standards have been attained. If these sampling results confirm attainment of LTSs, landfarm O&M will cease, and the landfarm will be closed. The performance monitoring schedule was accelerated to the first round of sampling during the month of August and the second in September 1996. The EPA agreed with ARCO/EPNG's proposal to combine these two sampling rounds into one sampling round consisting of twice the sampling point density. The higher density sampling provides a more representative result.

On August 20, 1996, eight five-point landfarm soil composite samples were collected. The EPA's on site representative from COE observed, and conducted QA/QC of the sampling. Samples were collected for the entire one foot treatment zone thickness using a hand auger. Photos 7-1 to 7-6 show sampling activities. Figure 7-3 shows the sampling locations. The samples were analyzed for PAHs by ACZ Laboratory in Steamboat Springs, Colorado. Laboratory analysis results are included in Appendix 7.5. Sampling results and the benzo(a)pyrene equivalent of individual PAHs are summarized in Table 7-6.

Table 7-6
August 1996 Performance Monitoring Sampling Results

	PM-CS-1			PM-CS-2			PM-CS-3			PM-CS-4			PM-CS-5		
PAHs	Conc. ppm	Q	Benzo(a) pyrene Eq. ppm	Conc. ppm	Q	Benzo(a) pyrene Eq. ppm	Conc. ppm	Q	Benzo(a) pyrene Eq. ppm	Conc. ppm	Q	Benzo(a) pyrene Eq. ppm	Conc. ppm	Q	Benzo(a) pyrene Eq. ppm
Benzo(a)anthracene	1.400	J	0.140	2.000	J	0.200	1.700	J	0.170	1.700	J	0.170	2.200	J	0.220
Benzo(b)fluoranthene	3.960	U	0.396	2.640	U	0.264	2.640	U	0.264	2.640	U	0.264	2.640	U	0.264
Benzo(k)fluoranthene	3.960	U	0.396	0.640	J	0.064	0.780	J	0.078	2.640	U	0.264	2.640	U	0.264
Chrysene	3.100	J	0.031	2.400	J	0.024	3.200		0.032	2.300	J	0.023	2.500	J	0.025
Benzo(a)pyrene	2.900	J	2.900	0.980	J	0.980	1.300	J	1.300	0.850	J	0.850	0.990	J	0.990
TOTAL			**3.863**			**1.532**			**1.844**			**1.571**			**1.763**

	PM-CS-6			PM-CS-7			PM-CS-8			PM-CS-40(1)			PM-CS-80(1)		
PAHs	Conc. ppm	Q	Benzo(a) pyrene Eq. ppm	Conc. ppm	Q	Benzo(a) pyrene Eq. ppm	Conc. ppm	Q	Benzo(a) pyrene Eq. ppm	Conc. ppm	Q	Benzo(a) pyrene Eq. ppm	Conc. ppm	Q	Benzo(a) pyrene Eq. ppm
Benzo(a)anthracene	2.600	J	0.260	1.400	J	0..140	1.500	J	0.150	2.100	J	0.210	1.200	J	0.120
Benzo(b)fluoranthene	2.640	U	0.264	2.640	U	0.264	2.640	U	0.264	2.640	U	0.264	2.640	U	0.264
Benzo(k)fluoranthene	0.740	J	0.074	2.640	U	0.264	2.640	U	0.264	2.640	U	0.264	2.640	U	0.264
Chrysene	2.800		0.028	2.500	J	0.025	2.300	J	0.023	2.500	J	0.025	1.900	J	0.019
Benzo(a)pyrene	1.100	J	1.100	2.640	U	2.640	0.860	J	0.860	0.970	J	0.970	0.860	J	0.860
TOTAL			**1.466**			**3.193**			**1.411**			**1.523**			**1.407**

(1) PM-CS-40 and PM-CS-80 are QA/QC Duplicate sample of PM-CS-4 and PM-CS-8 respectively
"U" Indicates compound was not detected
"J" Indicates compound detected < MDL
"B" Indicates compound was found in daily calibration blank

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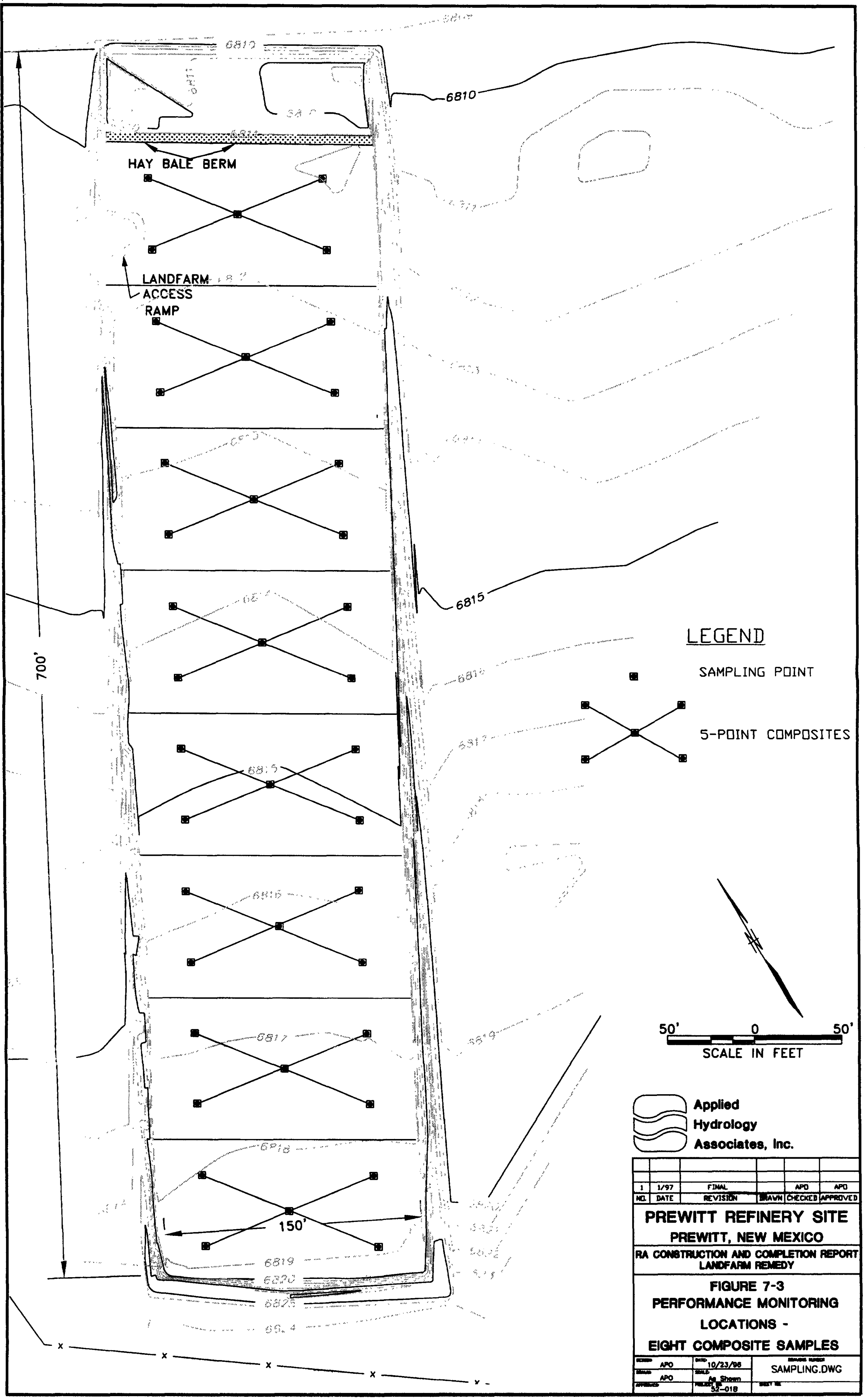
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6815
HAY BALE BERM
LANDFARM ACCESS RAMP
700'
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LEGEND
SAMPLING POINT
5-POINT COMPOSITES
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PREWITT, NEW MEXICO
RA CONSTRUCTION AND COMPLETION REPORT LANDFARM REMEDY
FIGURE 7-3
PERFORMANCE MONITORING LOCATIONS -
EIGHT COMPOSITE SAMPLES
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The results show that the individual PAHs concentrations are below the LTSs, and the total of benzo(a)pyrene equivalents of the PAHs range from 1.53 to 3.86 ppm with an average of 2.1 ppm, which is below the 4.5 ppm LTS. Analysis of the COE's QA/QC sample splits were conducted by Environmental Chemical Corporation, a COE-contracted laboratory. The results included in Appendix 7.6 are summarized in Table 7-7, which confirm that the LTSs have been attained.

Table 7-7

COE's August 1996 Performance Monitoring Sampling QA/QC Results

	PM-CS-1, 08-20-96			PM-CS-1, COE QA Split			PM-CS-3, 08-20-96			PM-CS-3, COE QA Split		
Conc.			Benzo(a) pyrene	Conc.		Benzo(a) pyrene	Conc.		Benzo(a) pyrene	Conc.		Benzo(a) pyrene
PAHs	ppm	Q	Equiv., ppm	ppm	Q	Equiv., ppm	ppm	Q	Equiv., ppm	ppm	Q	Equiv., ppm
Benzo(a)anthracene	1.400	J	0.140	4.000		0.400	1.700	J	0.170	4.130		0.413
Benzo(b)fluoranthene	3.960	U	0.396	2.330		0.233	2.640	U	0.264	2.100		0.210
Benzo(k)fluoranthene	3.960	U	0.396	2.400	U	0.240	0.780	J	0.078	2.630	U	0.263
Chrysene	3.100	J	0.031	7.360		0.074	3.200		0.032	6.810		0.068
Benzo(a)pyrene	2.900	J	2.900	2.460		2.460	1.300	J	1.300	2.460		2.460
TOTAL			**3.863**			**3.407**			**1.844**			**3.414**

"U" Indicates compound was not detected
"J" Indicates compound detected < MDL
"B" Indicates compound was found in daily calibration blank

After discussion of the August sampling results with the EPA, a second round of performance monitoring sampling consisting of four five-point composite samples was conducted on September 16, 1996. Sample locations are shown in Figure 7-1. The analytical results included in Appendix 7.5 are summarized in Table 7-8.

The results again demonstrate that the landfarm soil individual PAHs concentrations are below the LTSs, and the total of benzo(a)pyrene equivalents of PAHs range from 2.82 to 4.14 ppm with an average of 3.6 ppm, below the 4.5 ppm LTS.

Similar to the August sampling, the COE conducted QA/QC for this supplementary sampling. Analysis of the COE's QA/QC samples are included Appendix 7.6, which are summarized in Table 7-9. The results support attainment of the LTSs.

Table 7-8

September 1996 Performance Monitoring Sampling Results

PAHs	PM-CS-1			PM-CS-2			PM-CS-3			PM-CS-4			PM-CS-30(1)		
	Conc. ppm	Q	Benzo(a) pyrene Eq. ppm	Conc. ppm	Q	Benzo(a) pyrene Eq. ppm	Conc. ppm	Q	Benzo(a) pyrene Eq. ppm	Conc. ppm	Q	Benzo(a) pyrene Eq. ppm	Conc. ppm	Q	Benzo(a) pyrene Eq. ppm
Benzo(a)anthracene	2.200	J	0.220	3.600	J	0.360	2.500	J	0.250	2.000	J	0.200	2.400	J	0.240
Benzo(b)fluoranthene	3.300	U	0.330	3.630	U	0.363	3.300	U	0.330	3.300	U	0.330	3.300	U	0.330
Benzo(k)fluoranthene	3.300	U	0.330	3.630	U	0.363	3.300	U	0.330	3.300	U	0.330	3.300	U	0.330
Chrysene	3.200	J	0.032	3.300	J	0.033	3.300		0.033	2.600	J	0.026	3.400		0.034
Benzo(a)pyrene	3.100		3.100	1.700	J	1.700	3.200	J	3.200	2.700	J	2.700	3.200	J	3.200
TOTAL			**4.012**			**2.819**			**4.143**			**3.586**			**4.134**

(1) PM-CS-30 is a QA/QC Duplicate sample of PM-CS-3
"U" Indicates compound was not detected
"J" Indicates compound detected < MDL
"B" Indicates compound was found in daily calibration blank

Table 7-9

COE's September 1996 Performance Monitoring Sampling QA/QC Results

PAHs	PM-CS-2, 09-16-96			PM-CS-2, COE QA Split		
	Conc. ppm	Q	Benzo(a) pyrene Equiv., ppm	Conc. ppm	Q	Benzo(a) pyrene Equiv., ppm
Benzo(a)anthracene	3.600	J	0.360	2.230		0.223
Benzo(b)fluoranthene	3.630	U	0.363	2.010		0.201
Benzo(k)fluoranthene	3.630	U	0.363	2.560	U	0.256
Chrysene	3.300	J	0.033	5.970		0.060
Benzo(a)pyrene	1.700	J	1.700	2.230		2.230
TOTAL			**2.819**			**2.970**

"U" Indicates compound was not detected
"J" Indicates compound detected < MDL
"B" Indicates compound was found in daily calibration blank

7.8 Estimation of Contaminant Mass Removal Rate

Because the LTSs were initially attained and system modification was not necessary, determination of the contaminant mass removal rate was not crucial. Nevertheless, the contaminant mass removal rate was calculated using the performance monitoring results for documentation. The final PAHs mass was determined using 8,470,000 pounds of landfarm soil as discussed in Section 7.2, and the average performance monitoring results described in Section 7.7. The mass removal results are summarized in Table 7-10.

The calculations indicate that the total PAHs mass was reduced from 124.1 pounds to 84.8 pounds, a 31.7% removal rate during the two month landfarm O&M. The total benzo(a)pyrene equivalent mass of 31.6 pounds was reduced to 21.4 pounds, a reduction of 32.2%.

Table 7-10

Contaminant Mass Removal Rate

	Baseline (July 1996) PAH Mass, lbs				**Final PAH Mass, lbs**			
PAH	Avg. Conc. (1) ppm		PAH mass	Benzo (a)pyrene Equiv. mass	Avg. Conc. (2) ppm		PAH mass	Benzo (a)pyrene Equiv. mass
Benzo(a)anthracene	3.850		32.610	3.261	2.188		18.528	1.853
Benzo(b)fluoranthene	1.650	(3)	13.976	1.398	1.547	(3)	13.103	1.310
Benzo(k)fluoranthene	1.650	(3)	13.976	1.398	1.468	(3)	12.434	1.243
Chrysene	4.525		38.327	0.383	2.825		23.928	0.239
Benzo(a)pyrene	2.975		25.198	25.198	1.982		16.788	16.788
TOTAL			**124.086**	**31.638**			**84.780**	**21.433**

(1) Average of July 1996 baseline sampling concentration results
(2) Average of the August and September 1996 performance monitoring results
(3) Half of the MDL valve was used since compound was not detected

7.9 System Modification

No system modifications were necessary during the O&M because the LTSs were initially attained. In addition, the performance monitoring indicated adequate degradation of PAHs as discussed in Section 7.8. Nevertheless, one modification was made for application of water for irrigation in the areas of the landfarm not covered by the sprinkler system located on the berms. Four additional portable lines and sprinklers, as discussed in Section 7.3, were installed in an attempt to maintain optimum moisture level.

7.10 Determination of Performance Standards Attainment

As shown by performance monitoring and COE's QA/QC sampling results discussed in Section 7.7, the LTSs have been attained. Individual PAHs, as well as total benzo(a)pyrene equivalent content in the landfarm soil are below the LTSs. Determination of LTSs attainment is conservative because the full MDL value, rather than half the MDL, was used for benzo(a)pyrene equivalent calculations for PAHs which were not detected.

The performance monitoring results were submitted to the EPA in the monthly progress report. On October 22, 1996, during the telephone conference call between the EPA, EPNG Project Manager and the O&M Contractor, the EPA RPM notified that the performance monitoring results as well as the COE's QA/QC sample results demonstrate that the LTSs have been attained. The EPA also indicated that ARCO/EPNG should proceed with the Landfarm closure.

8.0 LANDFARM CLOSURE

The ROD specified treatment standards for the soils in the landfarm based on an excess cancer risk of less than or equal to 5×10^{-5} with direct exposure. The ROD further indicates that when the landfarm is closed with a soil and vegetative cover over the treated soils, the potential risk at the soil surface in the area of the landfarm will be less than 1×10^{-6}. As discussed in Section 7.0, the landfarm soil was treated to levels below the specified treatment standards. This section describes landfarm closure activities for placement of a soil cap and vegetative cover over the treated soils, which were conducted in accordance with the ROD and RD Report, Volume 4.0, to complete implementation of the Landfarm Remedy.

8.1 Landfarm Closure Requirements

In accordance with the ROD and the RD Report, Volume 4, the landfarm closure requirements consists of placing a soil and vegetative cover over the treated soils.

8.2 Pre Cap Placement Activities

Completion of the following activities was necessary prior to placing the cap over the treated soils.

8.2.1 Landfarm Berm Geomembrane Removal

The geomembrane covering the landfarm berms for erosion protection, was removed on November 4-6, 1996. A backhoe was used to excavate the trench where the geomembrane was anchored at the outside toe of the landfarm berms. Soils adhering to the geomembrane were removed even though the geomembrane was used to cover the clean soil berms. The geomembrane was then sized, rolled in small packages and was temporarily stored for subsequent off site disposal.

8.2.2 Hay Bale Berm Removal

The hay bale berm separating the landfarm soil from the catch basin had been covered with a permeable geotextile. During dismantling on November 6, 1996, the geotextile was removed, sized and rolled up in small manageable packages, and temporarily stored at the site for subsequent off site disposal. The hay bales were removed on November 7, 1996 and stored for straw mulching use during revegetation of the landfarm area.

8.2.3 Cap Subgrade Preparation

The average elevation of the landfarm treatment zone surface was approximately 1.4 feet below the surrounding surface grade. The landfarm was constructed in this manner to facilitate in-place capping of the treated landfarm soil. However, the top of the treatment zone elevation in the northern portion of the landfarm was similar to that of the surrounding grade outside the landfarm. Therefore, subgrade preparation work was necessary in order to place a uniform cap over all of the treated soil and maintain a uniform grade of the reclaimed area after the landfarm closure. The subgrade preparation work, which consisted of moving the treated soil above the liner from the north half of the landfarm to the deeper southern portion of the landfarm, was started on November 8, 1996.

All of the treated soil above the clay liner from the northern 350 feet of landfarm was moved with a dozer to the southern segment for subgrade preparation. Cut and fill stakes, at a 50' x 50' grid density, were used during the treated soil dozing to facilitate construction of an even subgrade. The landfarm soil dozing was completed on November 13, 1996. The EPA's on site representative, COE, inspected the landfarm area on November 13, 1996 and verified that the treated soil above the liner from the north half of the landfarm was moved to the southern part. The treated soils and buffer soils from the northern portion of the landfarm were removed down to the clay liner. A baseline elevation survey of the subgrade was conducted on November 14, 1996 at a grid density of 35' x 50'. The purpose of the survey was to assure that the subgrade elevations were at least one foot below the surrounding grade, so that a soil cap of at least one foot could be placed over the treated soils. The survey results, included in Appendix 8.1, show that the subgrade elevation at all but eight grid point locations was at least about one foot below the surrounding grade outside the landfarm. The eight locations, with less than one foot difference in elevations, were primarily near the landfarm berms. Stakes at the locations were marked with cuts required to achieve desired subgrade elevations. On November 19, 1996, the specified cuts were made at these locations, prior to the cap placement, so that the cap would be at least one foot thick at all locations.

8.2.4 Sprinkler System Removal

The sprinkler system piping had been placed within the landfarm berms, at a depth of approximately one foot. The sprinkler system consisted of 2½ inch Schedule 40 PVC piping and sprinkler heads. The sprinkler system removal activities started on November 18, 1996. The sprinkler heads were removed and salvaged. The PVC piping was excavated using a backhoe as shown in Photo 8-1. The piping was sized in small manageable pieces and temporarily stored for subsequent off site disposal. The sprinkler system removal activities were completed on November 19, 1996.

8.2.5 Catch Basin Liner

The catch basin had been constructed with a HDPE liner to receive any surface and subsurface drainage from the landfarm area due to heavy precipitation. However, no drainage from the landfarm accumulated in the catch basin during the landfarm operation, as all water from precipitation was absorbed in the landfarm. Therefore, the liner was not contaminated with hydrocarbons from the landfarm. The HDPE liner was removed on November 19 and 20, 1996. The liner was still in good condition, as the landfarm operated for only three months. A small piece of the liner, approximately 30' x 40', was salvaged for potential use during the subsurface remedial activities. The remainder of the liner was sized, rolled up in small manageable packages and temporarily stored for subsequent off site disposal.

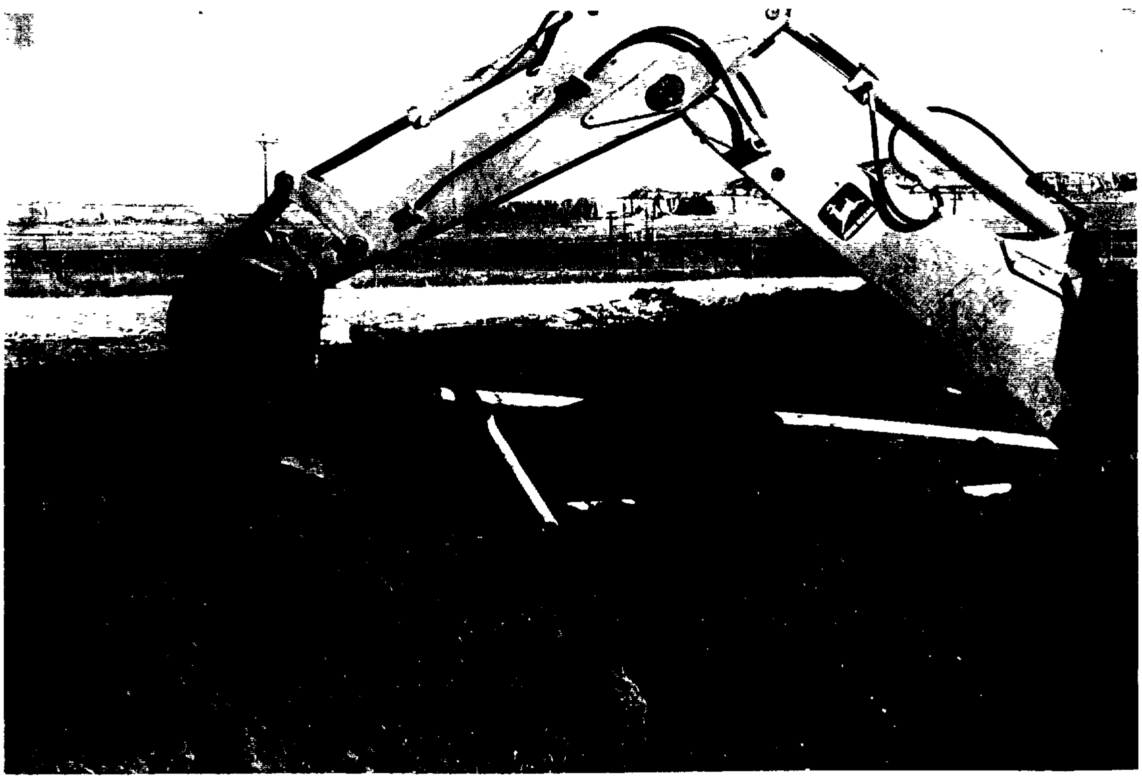


Photo 8-1. Sprinkler System Piping Removal.

8.3 Cap Placement

The soil cap placement activities started on November 19, 1996. The landfarm berms were constructed using approximately 1000 cu. yds. of clean soil, and were dozed over the treated soil, for the initial lift of the soil cap construction. Since a total of approximately 5400 cu. yds. of soil was needed for the cap, the remainder of the cap soil, approximately 4400 cu. yds., was hauled from the borrow area. The borrow area soil was previously sampled in 1995, which confirmed that the soil was clean.

The cap was constructed in lifts, and the soil was spread and compacted using a dozer. Photo 8-2 shows the cap soil hauled from the borrow area being placed over the treated soils. Photo 8-3 shows the cap soil dozing and compaction activities. Cut stakes which had been used for the subgrade preparation, were also used as fill stakes for cap placement. The cap placement was completed on November 21, 1996. Grading of the entire former landfarm area was performed using a grader, and was completed on November 22, 1996.

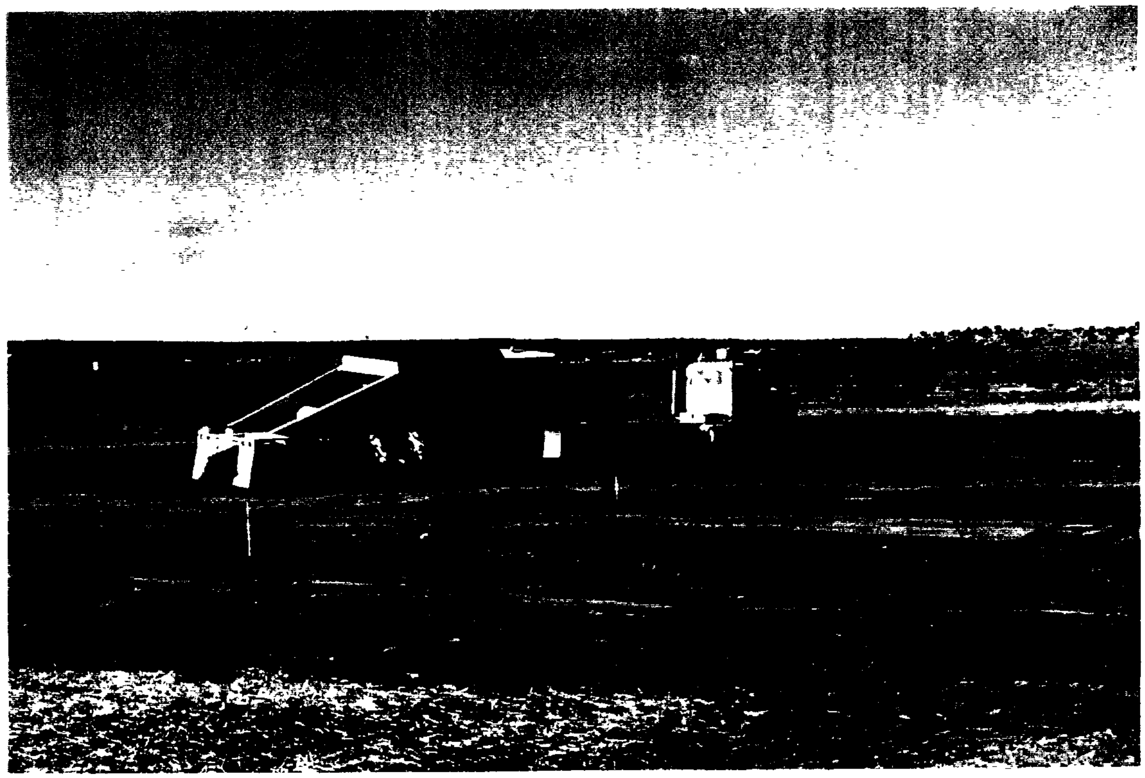


Photo 8-2. Cap Soil Placement

A final elevation survey was conducted on November 22, 1996 after completion of the cap placement and grading. Photo 8-4 shows the final graded surface and surveying activity. The survey results, included in Appendix 8.1, indicate the average cap thickness of 1.4 feet over the treated soils. This closure cap exceeds the soil and vegetative cover requirement specified in the RD Report and the ROD. The cap was constructed using a total of 5354 cu. yds. of clean soil. Approximately 500 cu. yds. of clean soils, stockpiled previously during the landfarm construction, was used for filling and grading the low areas outside the former landfarm.

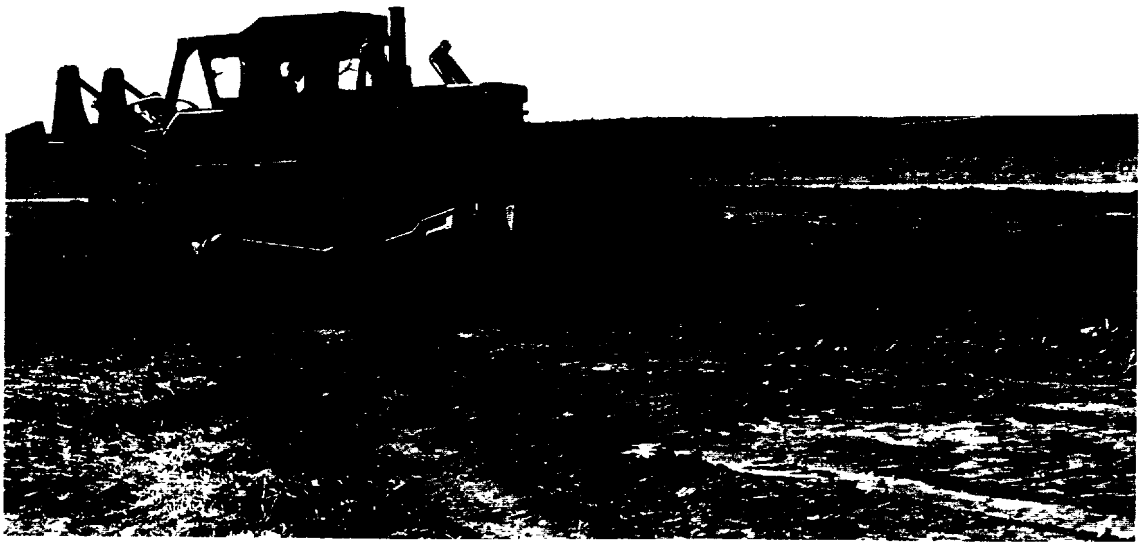


Photo 8-3. Cap Soil Dozing and Compaction

Photo 8-4. Final Elevation Surveying

8.4 Revegetation of the Cap and the Landfarm Area

Revegetation activities started on November 22, 1996 and were conducted in accordance with the RD Report specifications. Fertilizer was applied to the areas at a rate of approximately 50 lbs. of nitrogen per acre and 30 lbs of phosphate per acre. The areas were then disked and seeded, with seeding mixture and rates specified in the RD. Straw mulch was applied to the seeded areas at a rate of approximately two tons per acre. The mulch was then crimped into place using a notched disc. Photos 8-5 to 8-8 show the revegetation activities. The revegetation activities were completed on December 5, 1996. Photo 8-9 shows the landfarm during the operation and Photo 8-10 shows the landfarm area after completion of the cap and vegetation.

8.5 "As Built" Construction of the Cap

A plan drawing of the constructed cap is provided in Figure 8-1. This drawing shows the final topography of the former landfarm area. The cross sections through the cap as delineated in Figure 8-1 are shown in Figure 8-2. The cross sections show the clay liner, the original surface of the treated soil and the buffer layer, re-graded soil surface (cap subgrade), and soil cap. The cross sections and final topography were based on the civil surveys provided in Appendix 8.1.

8.6 Landfarm Closure Waste Management

The landfarm closure activities produced some minor debris. As discussed earlier in this section, the landfarm erosion protection geomembrane, sprinkler system piping, geotextile covering the hay bale berm, and HDPE liner from the catch basin liner were removed and prepared for subsequent off site disposal. Even though the landfarm soils were treated below the action level, and most of the material was not in direct contact with the landfarm soil, residual soils were removed from the debris. On December 2 and 3, 1996, this debris and used PPE generated at the site during the landfarm O&M and closure activities were transported to Waste Management of New Mexico disposal facility in Rio Rancho, New Mexico for disposal as non-hazardous waste. Waste shipment manifests are included in Appendix 8.2.

Photo 8-5. Seeding Fertilized and Disked Area Using a Seed Driller

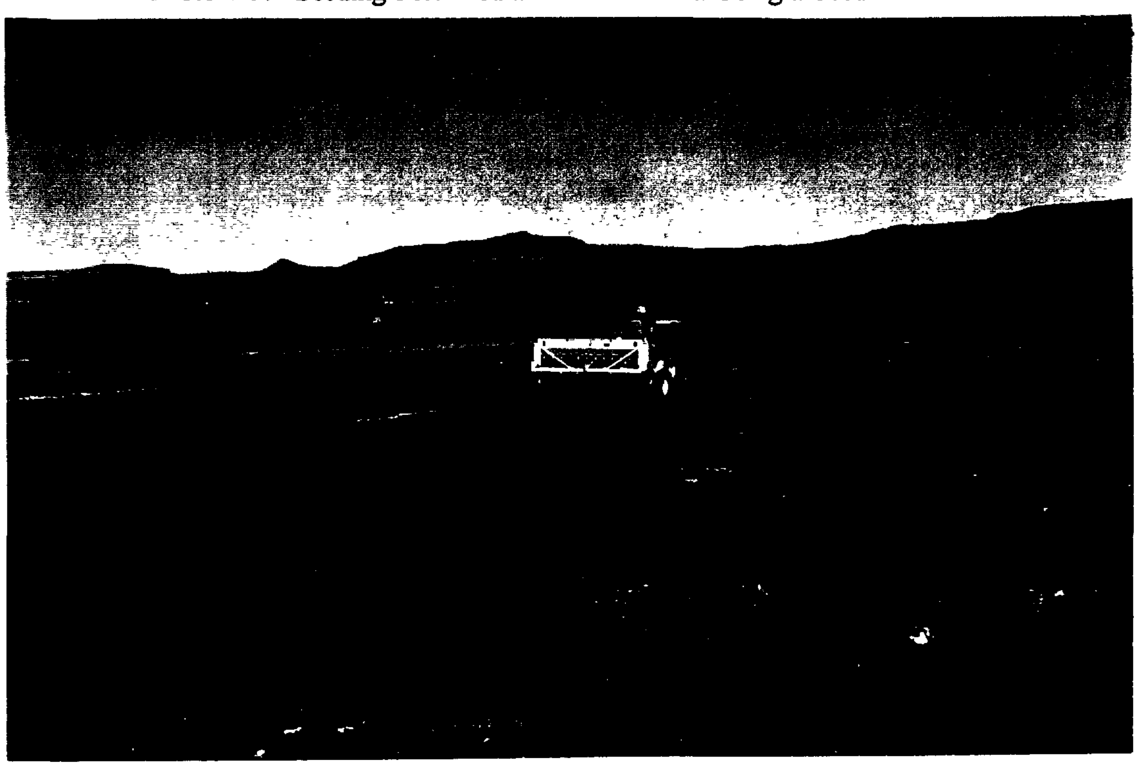


Photo 8-6. Seeding Fertilized and Disked Area Using a Seed Driller

Photo 8-7. Straw Mulching of Seeded Area

Photo 8-8. Crimping of Straw Mulch

Photo 8-9. Landfarm During Operation, August 1996

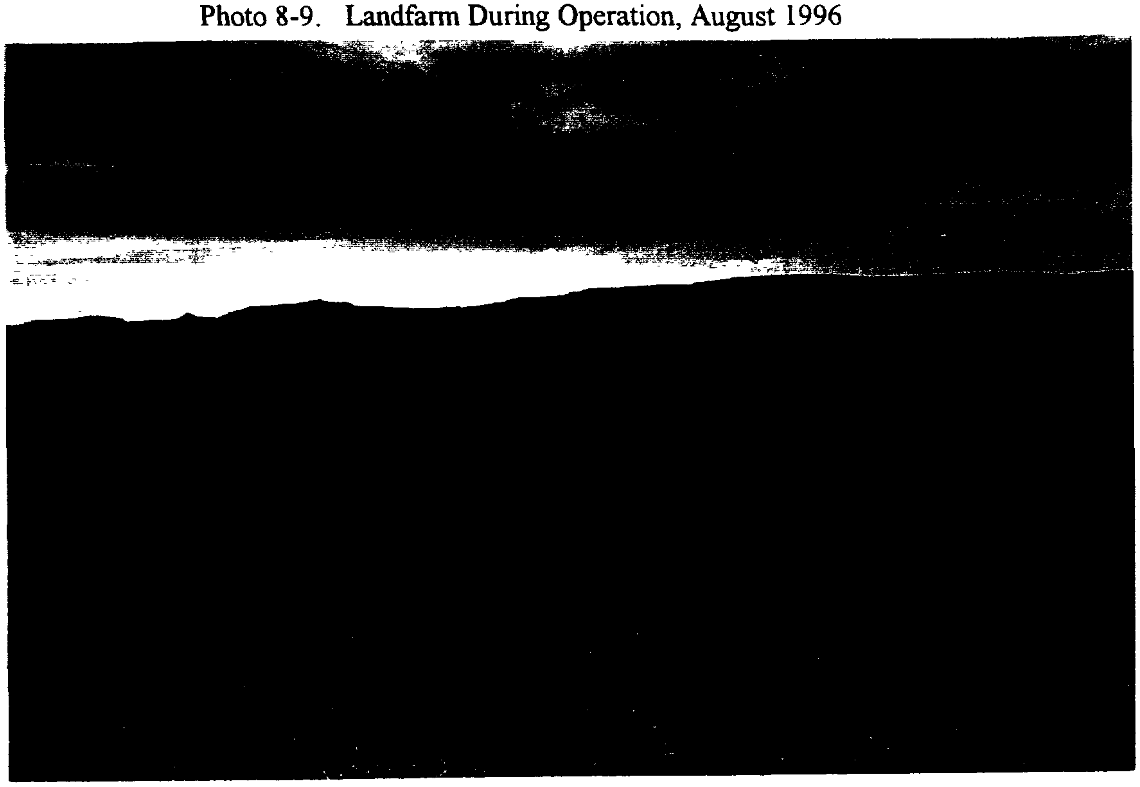
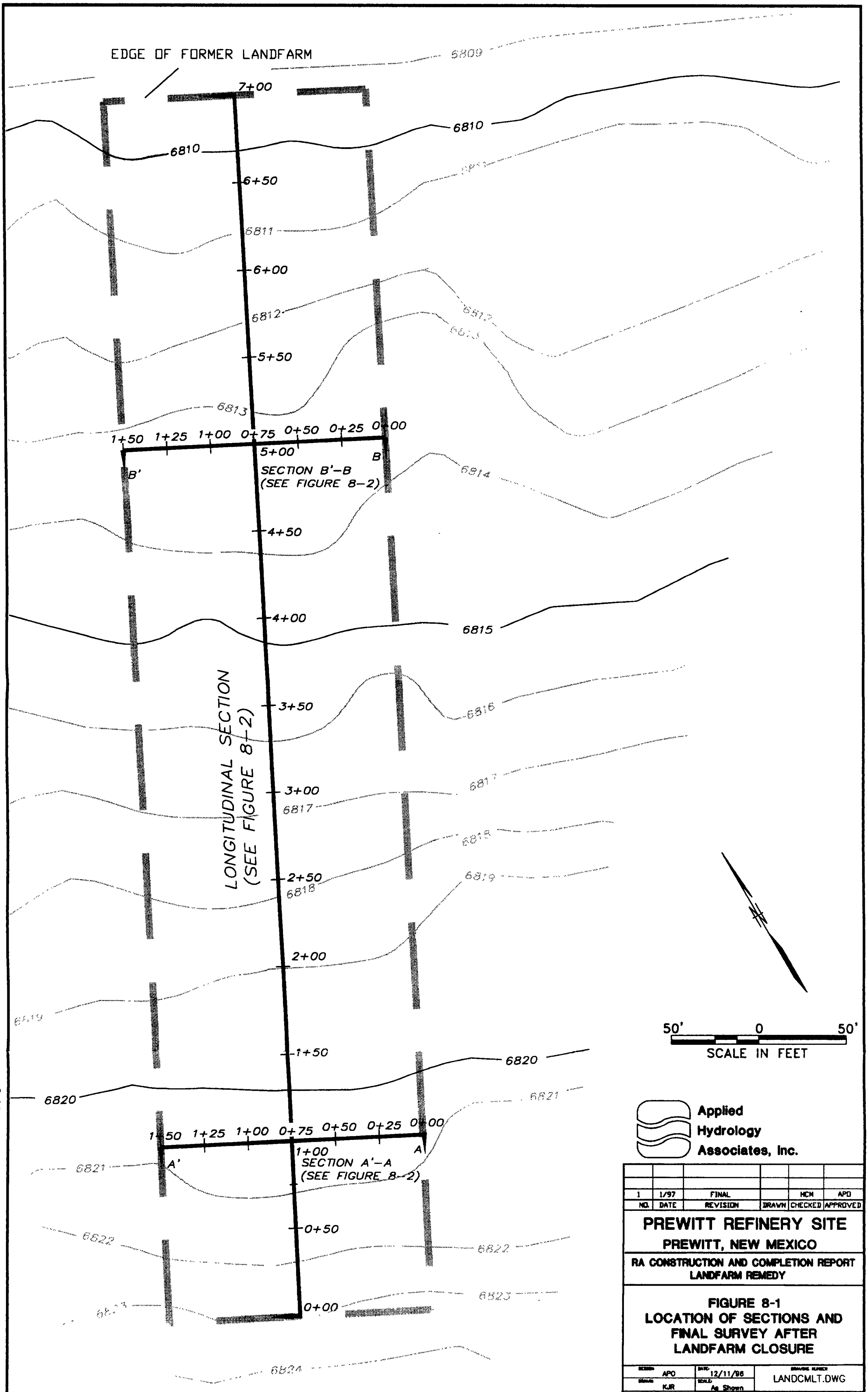


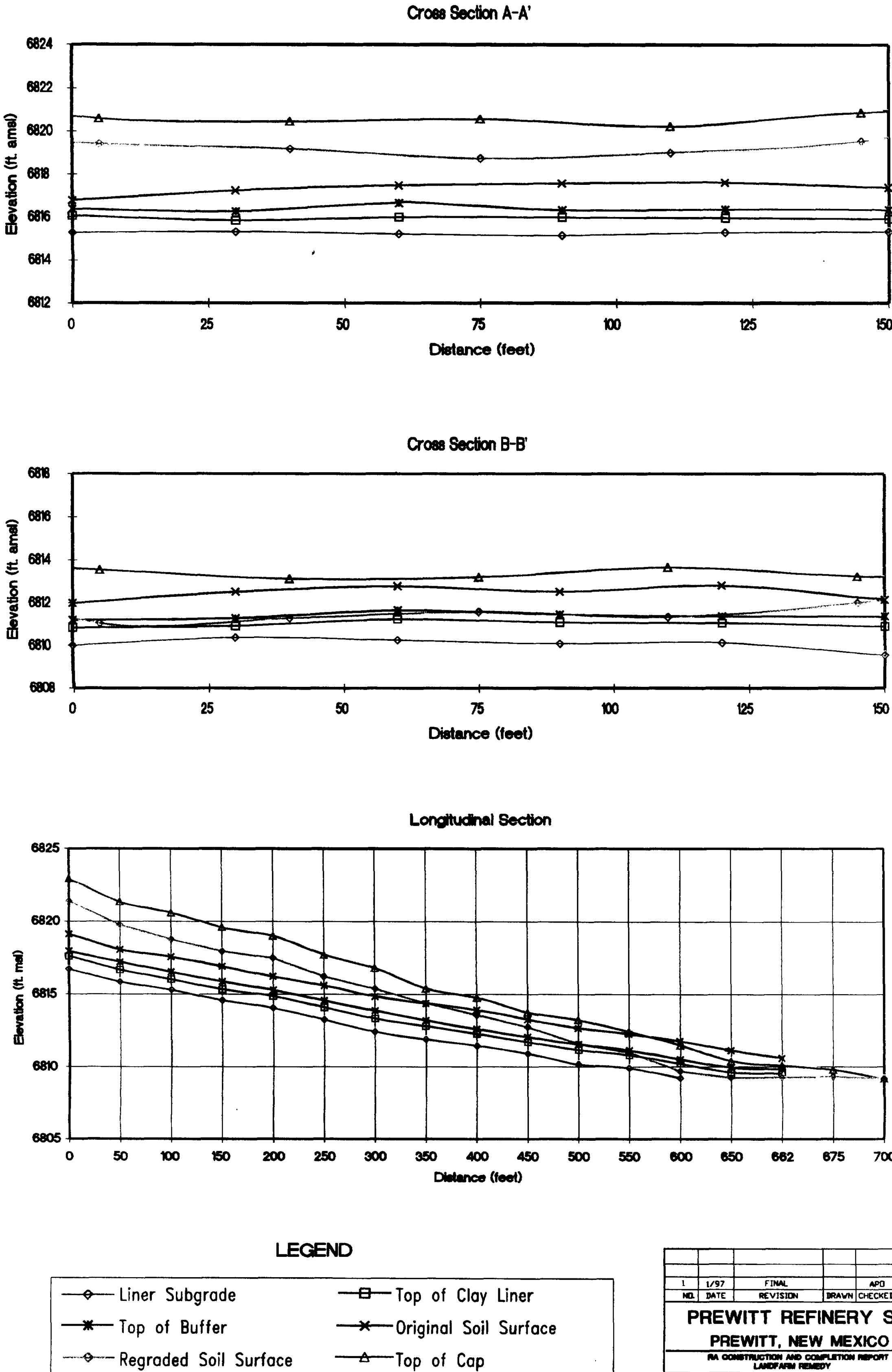
Photo 8-10, Former Landfarm Area, December 1996

This Document Contained an Oversized Document Which Was Not Filmed/Scanned

Title Prewitt Refinery Site - RA Construction and Completion Report - Landfarm Remedy - Figure 8-1 Location of Sections and Final Survey after Landfarm Closure.



EDGE OF FORMER LANDFARM
6809
6810
6811
6812
6813
6814
6815
6816
6817
6818
6819
6820
6821
6822
6823
6824
7+00
6+50
6+00
5+50
5+00
4+50
4+00
3+50
3+00
2+50
2+00
1+50
1+00
0+50
0+00
1+50 1+25 1+00 0+75 0+50 0+25 0+00
B' B
SECTION B'–B
(SEE FIGURE 8–2)
LONGITUDINAL SECTION
(SEE FIGURE 8–2)
A' A
SECTION A'–A
(SEE FIGURE 8–2)
N
50' 0 50'
SCALE IN FEET
Applied Hydrology Associates, Inc.
1 1/97 FINAL HCH APD
NO. DATE REVISION DRAWN CHECKED APPROVED
PREWITT REFINERY SITE
PREWITT, NEW MEXICO
RA CONSTRUCTION AND COMPLETION REPORT
LANDFARM REMEDY
FIGURE 8-1
LOCATION OF SECTIONS AND
FINAL SURVEY AFTER
LANDFARM CLOSURE
APD
KJR
12/11/96
As Shown
32-018
LANDCMLT.DWG



1	1/97	FINAL		APO	APO
NO.	DATE	REVISION	DRAWN	CHECKED	APPROVED

PREWITT REFINERY SITE

PREWITT, NEW MEXICO

RA CONSTRUCTION AND COMPLETION REPORT
LANDFARM REMEDY

FIGURE 8-2
LANDFARM CLOSURE
CROSS SECTIONS

Applied Hydrology Associates, Inc.

DESIGN	APO	DATE 12/11/96	DRAWING NUMBER LANDCMLT.DWG
DRAWN	KJR	SCALE As Shown	
APPROVED		PROJECT NO. 52-018	SHEET NO.

During a general cleanup and consolidation of waste for shipment, a drum containing oil sludge was discovered in the South Area where both empty and PPE drums were stored. The oil sludge was gathered during the previous debris and subsurface pipe cleanup work, and was inadvertently placed with other drums. The oil sludge was to be treated in the landfarm, but apparently was overlooked during the landfarm soil preparation and placement. This matter was discussed with the EPA RPM on November 19, 1996 via telephone conversation, and it was agreed that the oil sludge would be disposed off site in an appropriate disposal facility. A sample of the oil sludge was collected on November 20, 1996 and sent to ACZ Laboratory in Steamboat Springs, Colorado for waste characterization. The sampling results show the oil sludge is a non-hazardous waste. On December 12, 1996, the oil sludge was transported to Laidlaw Environmental Services disposal facility in Phoenix, Arizona. The sampling results, waste profile, and the manifest are included in Appendix 8.2.

8.7 Pre and Final Certification Inspection

On November 22, 1996, EPA conducted the pre-certification inspection for the Landfarm Remedy. ARCO/EPNG representatives, O&M Contractor, SC/QAO Contractor, EPA's Remedial Project Manager (RPM), and EPA's on-site representative inspected the former landfarm area. Details of the landfarm closure activities were discussed with the EPA. The EPA was notified that the revegetation and off site disposal of the derived waste will be completed by the first week of December 1996. The EPA RPM indicated that with completion of revegetation and waste shipment, the landfarm closure work was acceptable and complete. In addition, the EPA indicated that this inspection also constitutes the final certification inspection. As discussed earlier in this section, revegetation and shipment of the waste has been completed.

8.8 EPA Certification of Completion

As specified in the Order and the RA Work Plan, the EPA issued a Certification of Completion of the Landfarm remedy following the Certification Inspection and review of the Draft Remedial Action Construction and Completion Report. The EPA Certification of Completion, dated January 23, 1997 is provided on the following page.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

JAN 2 3 1997

RECEIVED
JAN 27 1997
ENVIRONMENTAL AFFAIRS

Mr. Gerry Garibay
El Paso Natural Gas Company
P.O. Box 1492
El Paso, Texas 79978

Mr. Ron Ziegler
ARCO
307 East park Avenue
Suite 400
Anaconda, Montana 59711

Re: Certification of Completion of the Surface Remediation
Prewitt Abandoned Refinery Superfund Site, Prewitt, New Mexico

Dear Gentlemen:

On March 19, 1996, the U.S. Environmental Protection Agency (EPA) sent you a letter providing you with notification that the Remedial Action for the surface soils, exclusive of the landfarm activities, had been completed. Since that time, you have submitted the Draft Remedial Action Construction and Completion Report - Landfarm Remedy. EPA, the New Mexico Environment Department (NMED) and the Navajo Nation Superfund Office (NSO) have completed their review of the aforementioned document. Based on the information contained in the report and the pre-certification inspection, and in accordance with Unilateral Administrative Order (6-17-93) EPA is providing ARCO and El Paso Natural Gas with notification that the Remedial Action for all surface soils has been completed. Additionally, since all of the surface contamination has been remediated, the signs located on the perimeter fence can be removed.

EPA looks forward to working with the companies on the completion of the subsurface remediation. If you should have any questions, please contact Ms. Monica Smith at (214) 665-6780.

Sincerely,

Carl E. Edlund
Chief
Superfund Branch

cc: Ed Kelley - NMED
Benny Coho - NSO
Brian Jordan - COE

APPENDIX 2.1

REMEDIAL ACTION SAMPLING AND ANALYSIS PLAN ADDENDUM

Asbestos Confirmatory Sampling Procedures

INTRODUCTION

Soon after beginning activities to remove friable and non-friable asbestos containing materials (ACM) from the Site it became apparent that the amount of asbestos at the Site was far more extensive than indicated by the locations specified in the Remedial Design Report. This revised sampling plan provides guidelines for confirmatory sampling and analysis procedures which will be conducted following the removal of additional friable ACM. Based on the locations where ACM has been identified it is anticipated that this plan will involve extensive sampling with more than 100 composite samples taken from more than 500 soil sampling points.

SAMPLING STRATEGY

As part of the removal activities of friable ACM now being carried out, the entire Site has been divided into a 50 x 50 foot grid to facilitate the identification, removal, and confirmatory sampling of asbestos. Once removal activities of ACM have been completed for any contiguous area, the size of that area will be determined and composite confirmatory soil samples will be obtained and sent to a qualified laboratory for analysis.

SAMPLE COLLECTION PROCEDURE

Confirmatory soil samples will be collected following the removal of any ACM from a single contiguous area. Procedures for minimizing the airborne release of asbestos fibers and decontamination of equipment outlined in the Remedial Design Report will be followed. Soil samples from the locations where friable asbestos has been removed will be collected from the depth interval of 0-3 inches of the existing ground level using a scoop, trowel, or small diameter soil sampling tube. Approximately 10-30 grams of soil will be collected at each location.

A composite sample from five sampling locations will be made by combining each in a resealable plastic bag. The locations of the five part composite will be a center point and four points on a 3 to 5 foot radius from the center and separated by 90 degrees. A composite sample taken following these guidelines effectively samples an area of about 100 ft^2 and a soil volume of about 1 cubic yard. The number of five part composites to be collected will be determined by the size of the area where a removal activity has been completed.

The size of each removal area will be defined by percentage of 50 x 50 foot square relative to the removal area. In any 50 x 50 foot square with 50% or less of the area (625 ft^2) occupied by a friable ACM removal area, one to two composite sample will be collected. Three to four composites will be collected in any removal area which occupies greater than 50% of the 50 x 50 foot square (1250 ft^2). Professional judgment and discretion will be used to define the location and number of samples to be collected within these limits and the extent of contiguous removal areas.

SAMPLE IDENTIFICATION

Confirmatory asbestos soil samples will be labeled with the grid coordinates (50 x 50 foot grid) in which they are located, followed by the letter "A" and a sequential number for each composite (1, 2, etc.) within the 50 x 50 foot square. Typically, this total number of samples from a grid should be less than four. However, five or more samples could occur depending upon the number of isolated (non-contiguous) friable asbestos removal areas found within the grid, as each location would have at least one sample.

> EXAMPLE (P27A-5). P and 27 are the grid coordinates and 5 is the composite identifier. Composite number 5 would be used only if five composite samples were obtained in any 50 x 50 foot square (greater than 50% of the 50 x 50 foot was occupied by an ACM removal area plus an isolated ACM removal area; five isolated areas, etc.). Pin flags will be used to designate where the center point of each composite was obtained and the approximate location within the 50 x 50 foot grid will be noted in a field notebook.

CONFIRMATORY ANALYSIS

Confirmatory samples will be analyzed for bulk asbestos using polarized light microscopy in accordance with the RA Sampling and Analysis Plan. If analytical results indicate that the composite soil sample contains greater than 1% asbestos (based on a representative composite sample of about 1 cubic yard of soil, the sample location will be considered asbestos containing material (ACM) and additional removal will be required. If analytical results indicate that the composite sample contains less than 1% asbestos, the soil will be considered as non-ACM and no further action is required.

Representative samples of some of the various ACM types found at the Site were obtained during the Remedial Design Site inspection. These samples were kept on-site for use as a visual guide to help identify ACMs in the field. On the occasions when materials were found in the field that could not be matched to a sample type in the visual guide, additional samples were submitted to the laboratory for analysis of asbestos by polarized light microscopy (PLM).